PERIODICAL ROOM
GENERAL LIBRARY
UNIV. OF MICH.

SCIENTIFIC AMERICAN

MICRO MOTION-PICTURES
By Heinz Rosenberger

MARCONI STRIDES ONWARD

WHAT IS THE SIMPLEST ELEMENT?

SWAMP RECLAMATION UP-TO-DATE

35¢ a Copy

MARCH 1927

$4.00 a Year

—for the Bearings that Outlast Your Car

Your comfort and safety! They demand bearings of the hardest, toughest, most wear-resisting steel ever developed.

That is what you get when the bearings are Timkens—special electric furnace alloy steel of unequaled durability, perfected by Timken metallurgists and produced in the Timken steel mill, whose output of electric furnace steel is the largest in the world.

Before you buy, check for Timken Bearings in the vital chassis units—transmission, differential, pinion or worm drive, front wheels, rear wheels, fan and steering pivots.

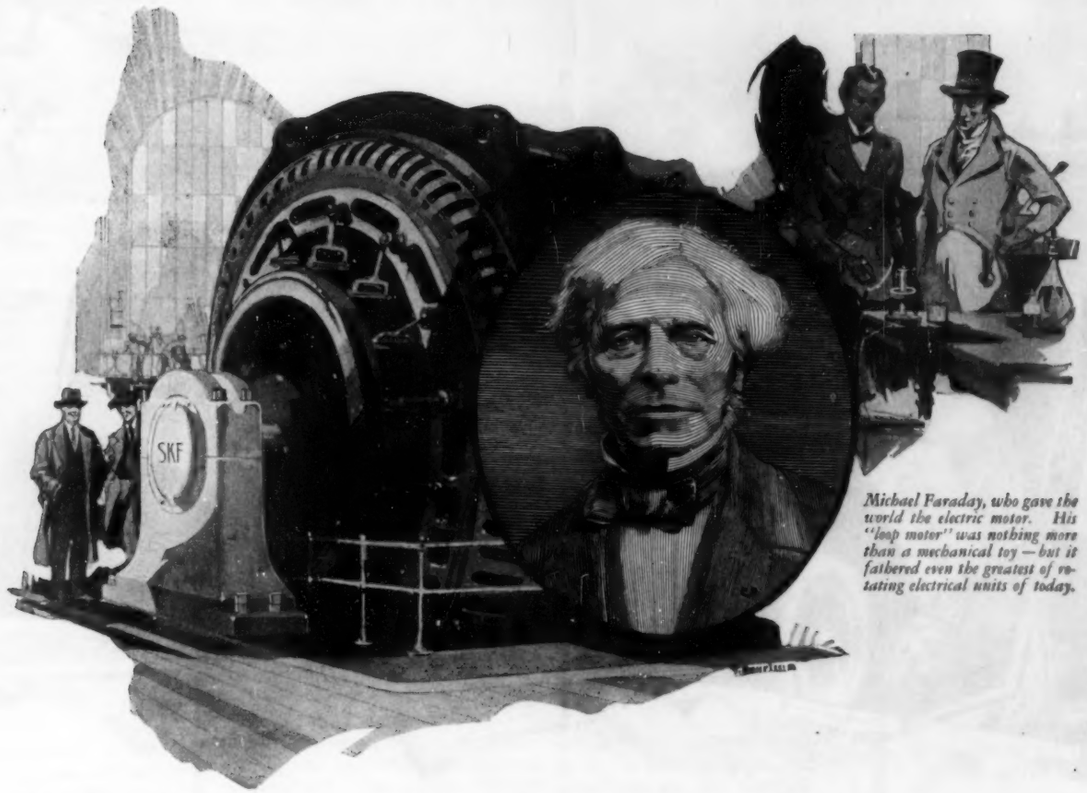
Wherever you find Timkens you are sure of the durability, comfort, attentionless service, and safety that are exclusive with the tapered design, *POSITIVELY ALIGNED ROLLS*, and supremely enduring steel of Timken Bearings.

THE TIMKEN ROLLER BEARING CO., CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

A comet's tail flies from the water-cooled hot-saw as it whirls its way through 6-inch bars of steel in the Timken steel mill

Printed in the United States, by ANDREW H. KELLOGG CO.



Michael Faraday, who gave the world the electric motor. His "loop motor" was nothing more than a mechanical toy—but it fathered even the greatest of rotating electrical units of today.

Faraday's Motor Turned on Plain Bearings— the Modern Motor on SKF

JUST a unique little toy—that first motor of Faraday's, but the first whining song of its spinning armature carried a promise, to all industry, of bigger things to come.

And the electric motor of today has fulfilled that promise.

It has been the privilege of SKF to contribute, to a great extent, the ball and roller bearings that make present day electric motor performance possible. Forty-five of the leading electrical manufacturers of the country use SKF-marked Ball or Roller Bearings on rotating electric machinery of all kinds, from the small, fractional horse-power motor, to the huge, generating unit.

SKF-marked Bearings, in electrical machinery, show no appreciable wear, even after years of grueling service. And wear, in electric motor bearings, is the factor that throws the armature out of alignment, destroys the uniformity of the air-gap and, in general, prevents the motor from operating at its highest efficiency.

SKF on Hess-Bright or Skayef Ball or Roller Bearings is both the mark of highest bearing quality and the symbol of a world-wide organization of anti-friction specialists

©1927 SKF INDUSTRIES, INC. 165 BROADWAY NEW YORK 1753

THE SCIENTIFIC AMERICAN, March, 1927. Volume 136, Number 3. Published monthly by Scientific American Publishing Company, at 24-26 West 40th Street, New York, N. Y., and printed in the U. S. A. Subscription price, $4.00 per year. Entered as second-class matter June 18, 1879, at the post office at New York, N. Y., under the act of March 3, 1879. Copyright, 1927, by Scientific American Publishing Company. Great Britain rights reserved. Illustrated articles must not be reproduced without written permission. The use of Scientific American articles or quotations from them for advertising and stock-selling enterprises is never authorized. "Scientific American," Registered United States Patent Office.

Illustrating the New International Chain-Drive Truck with All-Steel Cab

Making it easy for others to follow

"We want you to know that we are enjoying complete satisfaction from our International Trucks. Our rapidly increasing business is due in large part to the unfailing performance of our International Fleet. When we buy more trucks, we will buy Internationals."

RALPH L. NICHOLS,
President,
Tampa Rock Co.
Tampa, Fla.

OVER a billion dollars a year for building roads and maintaining them—one of the biggest industries in the country and one of the hardest jobs that motor trucks are given to do.

More than 55,000 miles of hard roads will be constructed in the United States during 1927—think of it—fifteen times across the continent! And where the going is hardest, where roads have never been before, there International Trucks are blazing the trail and paving the way—making it easy for others to follow!

Road reconstruction in old New England, putting a solid footing through the sands of the south, pulling Iowa out of the mud, or tearing away hills in California—it's all in a day's work for International Trucks because that kind of work was built into them at the factory.

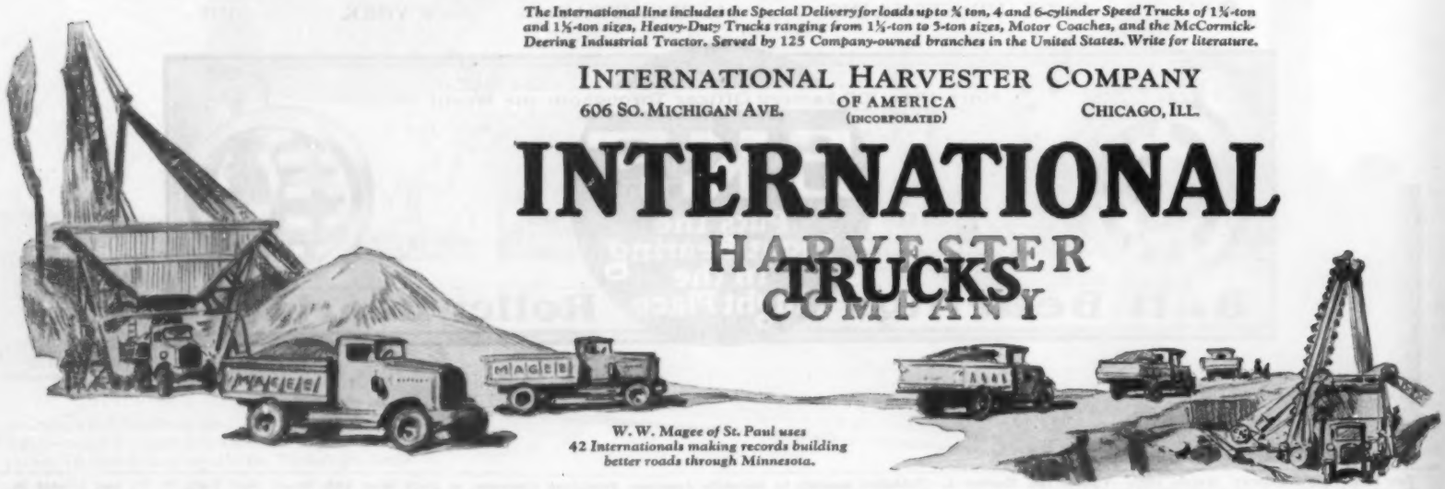
The Harvester Company has been building good trucks for more than twenty-two years, and they are building better trucks now than ever.

Write us and we will give you the names of contractors who build roads with International Trucks in your own part of the country,—such men, for instance, as S. R. Rosoff, New York, who operates 32 Internationals; L. M. Gray of Jacksonville, 18 Internationals; M. O. Weaver of Iowa Falls, 41 Internationals; and Claude Mayhugh of Los Angeles who owns 26 Internationals.

The International line includes the Special Delivery for loads up to ¾ ton, 4 and 6-cylinder Speed Trucks of 1½-ton and 1½-ton sizes, Heavy-Duty Trucks ranging from 1½-ton to 5-ton sizes, Motor Coaches, and the McCormick-Deering Industrial Tractor. Served by 125 Company-owned branches in the United States. Write for literature.

INTERNATIONAL HARVESTER COMPANY
606 SO. MICHIGAN AVE. OF AMERICA (INCORPORATED) CHICAGO, ILL.

INTERNATIONAL HARVESTER COMPANY TRUCKS



W. W. Magee of St. Paul uses 42 Internationals making records building better roads through Minnesota.

SCIENTIFIC AMERICAN

THE MAGAZINE OF TODAY AND TOMORROW

NEW YORK, MARCH, 1927 | *Edited by* ORSON D. MUNN | EIGHTY-THIRD YEAR

WORLDWIDE

"CAN America Compete?" This is the title of a reassuring book just issued by the India House, New York, an American exporter's organization. It seems that while we Americans have tended to notice those cases in which we have been outdone in foreign trade by other nations, the trade consuls of these same foreign nations have been emphasizing at home that we are outtrading *them!* Thus a kind of "inferiority complex" has developed on both sides.

Just before we drafted this note, while awaiting a belated train in a western New York State city, we watched a freight train pass. On it we counted nine cars of automobiles boxed and destined for the seaboard. Hastily we jotted down their several destinations: Sydney, Colombia, Calcutta, Buenos Aires, London, Porto Alegre, Helsingfors, Cape Town.

What a striking commentary on this very question! Thrilling, too—if one's romantic imagination has not atrophied—these American motor cars starting out for the utmost ends of the earth, destined soon to carry foreign peoples over the plains, deserts, mountains, and rutty roads of five continents.

Perhaps, after all, America can compete!

INTOXICATION

HOW you get intoxicated and how intoxicated you get depend not so much upon what you drink as upon what you are, reports Dr. N. D. C. Lewis, clinical psychiatrist at the Federal Institution for the Insane, or, as he puts it, "the type of behavior released by the use of alcohol depends upon the fundamental constitution of the person consuming it."

Dr. W. C. Sullivan, studying along the same lines, finds that alcoholic reactions involve different factors of the sexual, ego and herd instincts. Small doses of alcohol promote sociability and lead to a relaxation of social or herd conventions, a reaction noted particularly on festive occasions.

"The amount of alcohol is frequently comparatively small considering its result in perverted instinctive reactions, brutal destructive impulses, coarse sensual aggressions, comatose end-results and amnesias," he says.

He names six main reaction types having a particular relation to alcoholic indulgence.

The research of these men is not academic; it is practical. And the fact that such study is more necessary today, when the sale of liquor is banned by law, means that something is wrong somewhere.

In This Issue

Life Artificially Maintained

For 14 years, day in and day out, a little group of cells from a chicken has been steadily reproducing itself in a glass jar. Recently a way was found to make motion pictures of these microscopic cells by a remarkable new technique. On pages 166 and 167 the man who did it explains how it was actually accomplished.

The Chemistry of the Future

Are we now living on the threshold of a still greater age of chemistry than the present? Some think so. On pages 162 and 163 certain fundamental reasons for this belief are outlined in a lucid article by a well-known chemist.

Radio Now Links England's Colonies

For several years Marconi, father of wireless, has been working on a directional method of transmission that is both reliable and efficient. He has now succeeded in putting the system on a commercial basis. The story is told on pages 174 and 175.

Inventor, Sculptor and Naturalist

Thus is described, Carl Akeley, some of whose work in bringing the world a knowledge of Africa is told on pages 182 and 183. One of Mr. Akeley's ambitions was the establishment of a gorilla sanctuary in Africa—and he succeeded.

MORE THAN 200 PICTURES

Complete table of contents will be found on page 224.

For Next Month

Evolution Once More Brilliantly Vindicated

Few anti-evolutionists have known that there was an immense gap in the evolutionary tree of our descent—a gap filled in only by inference. That gap has now been bridged. The previous inferences prove to have been *right!* The story is told by a noted scientist.

Fishes That Can Shock You

Small fishes that give large electric shocks—enough to do serious injury—are not so rare as many think. Their form of defense is most interesting. In our April issue Dr. David Starr Jordan, noted ichthyologist and writer, will tell about these fish.

Wood as a Conductor of Electricity!

A series of experiments performed in Germany have revealed some startling facts about adhesive forces between wooden contacts carrying a minute current of electricity. The story of the work with these "breath currents," as the discoverer terms them, may be the beginning of a new epic in the history of applied electricity.

Other articles on—Twentieth Century Railroad Building; Millions Lost Yearly Through Soil Erosion; Bringing the Colorado River to Southern California; Marvels of Modern Photography; The Reconstructed Battleship *Texas;* Giant Lifting Magnets Save Labor; The Month in Medical Science; Radio; Astronomy; Successful Inventors.

MORE THAN 200 PICTURES

¶ **Smatterings of half-baked science you can pick up anywhere. The facts you find in the Scientific American.**

For only $4 the Scientific American keeps you informed for a year.

SACRED?

IN the world of science, an unwritten but sacred tradition demands that, when a worker completes research suggested by previous workers, due credit must be accorded them on publication, for their part in it. In 1919 Dr. Elihu Thomson of the General Electric Company's Lynn laboratory communicated to scientists his belief that, if the nitrogen in the air supplied to divers and caisson workers, were artificially replaced by the highly diffusive gas, helium, it would prove possible to remove these workers from high air pressure twice as quickly as at present.

Recently, the United States Bureau of Mines published accounts of the highly successful outcome of the suggested experiments, an outcome whose economic value will not be small. But no credit was given to the source of the suggestion. Dr. Thomson says he has received nothing definite in answer to a letter sent to the Bureau months ago.

Is the sacred tradition weakening?

NAVAL

WE have all heard of the military instruction which the Army maintains at several of our universities and colleges, where students who take the military course may qualify for commissions as reserve officers of the Army. And now the Navy has established a similar system at Yale University. There will be 60 students in each class, commencing with the freshman class of this year, and the course will extend over four years. There is need of such an adequate naval reserve; for Annapolis is unable to meet the demand for officers. We strongly commend this course to those men who, under the urge of patriotism, wish to uphold the security and dignity of their country.

COOL

"ONE could not help feeling that this was a sort of thing which should not happen." Thus does an important medical journal coolly characterize the unfortunate outcome of an operation performed on a patient. It seems that a pair of six-inch forceps was accidentally sewed up in the abdomen, necessitating a second operation. Operation Number 2 was successful, the forceps being recovered, but the patient died.

We incline to agree with the frank opinion that "this was a sort of thing that should not have happened," although the relatives—and, in fact the rest of us—may possibly consider the matter-of-fact verbiage somewhat mild!

This is the sort of happening that provides quacks and anti-medical cranks with ammunition to fire at the doctors.

This is more than a dotted line.

IT is a *key* which unlocks the secrets of the laboratories and workshops of the men who are accomplishing great things in the world.

IT is a *door* opening upon the marvels of science which thrill you as they unfold before your eyes.

IT is a *highway* leading to a broad understanding of what is going on about you.

IT is the first rung of the *ladder* up which you mount to knowledge of the thoughts and actions of the world's outstanding thinkers and doers in science.

TELL your friends of the dotted line. See that they reply with a dash—a dash to the nearest mail box, so that they, too, may have for their own all that the dotted line means.

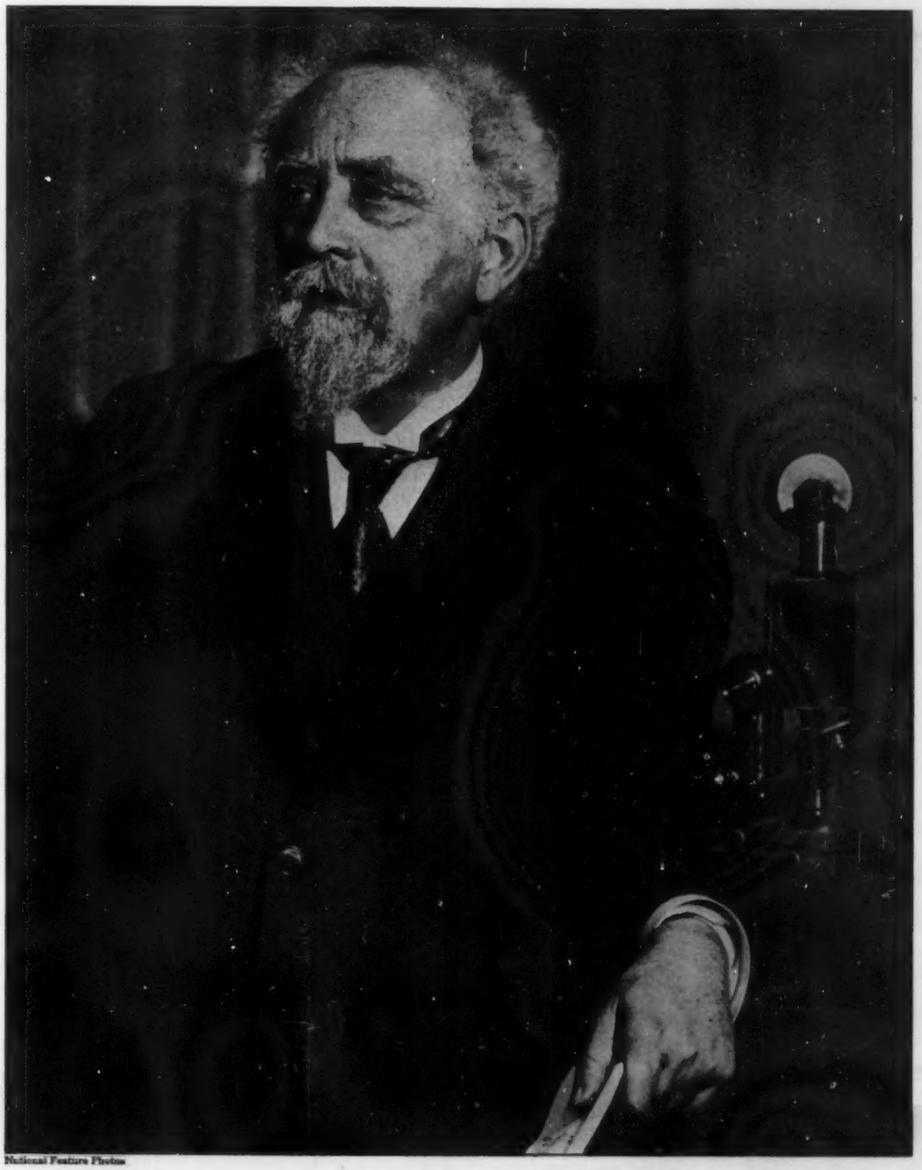
Scientific American
24 W. 40th St.
New York City

Send me Scientific American for a year. Enclosed is my check for $4.00.

Name.....

Street and No. .....

P. O. ..... State.....



National Feature Photos

Professor Jean Baptiste Perrin, New Nobel Physics Prize Winner

This year the famous Nobel Physics Prize was awarded to Professor Jean Baptiste Perrin, of the Sorbonne, University of Paris, for his many important researches, especially on the molecules of gases and on the chemical effects of light. Professor Perrin has long been noted for his studies of the so-called "Brownian movement." Exactly a century ago the British botanist Brown discovered that extremely minute particles of matter suspended in water maintained a constant "dance," as if they were frequently bumped by invisible projectiles. He noted that the effect increased as the size of the particles decreased, and he correctly inferred that the jolts received were actually due to the rapid impact of molecules of the liquid in which the particles were suspended. This molecular bombardment "dance" is the Brownian movement, and it may be observed by anyone having access to a good microscope. Professor Perrin, the new prize winner, has quantitatively studied this interesting phenomenon, using extremely small grains of mastic in emulsion in water. His careful observations beautifully confirm the kinetic theory of gases—the pressure of a gas is best explained as due to the impacts of its molecules against each other and against the walls of the containing vessel. Professor Perrin's research is explained in his book, "Brownian Movement and Molecular Reality," translated into English by Professor Frederick Soddy, noted British physical chemist

Courtesy of the American Museum of Natural History

Reproducing the Wonders that Are Africa's

In the African Hall of the American Museum of Natural History, not as yet built (see pages 184 and 185), there will be a frieze of bas-relief panels in bronze, surmounting various animal groups. The photograph reproduced above shows one of the completed units. The upper panel illustrates a Dorobo family and their native hut. The man is skinning an antelope—the result of his day of hunting. Looking on are a pair of hunting dogs, the only domestic animals kept by these people. The man's wife and children stand nearby. Below the panel is a group of African lions against a background depicting daybreak at a water hole. The superbly mounted animals in the foreground, together with the surrounding grasses, blending with the background, form a picture difficult to describe adequately. This completed example of artistry is now on exhibition in a temporary African section and only waits the erection of the proposed African Hall, when it will be placed permanently with similar exhibits.

Courtesy Paramount Pictures

THE SAHARA TRANSPORTED TO ARIZONA

This photograph was taken "on location" for the motion picture "Beau Geste." The sand dunes hide the loudspeaking telephones used by the directors

The Signal Corps of the 'Movies'

Signal Systems Using Telephones, Radio, Electric Lights and Flags, Make Possible the Direction of Large Groups of Actors

By A. P. Peck

WHEN viewing one of the large, spectacular motion pictures that are so popular today, the average person does not usually realize the vast amount of time, money and energy that has been spent in producing the effects which, on the screen, last for only a few minutes.

True, publicity stories in the various newspapers and popular motion-picture magazines often tell us that "a million dollars were spent" in the production of this or that picture. But, because so much has been said and written about the various tricks that are employed in motion-picture work, quotations of costs, such as that mentioned, are usually taken with the proverbial grain of salt. However, pictures occasionally appear that actually live up to the cost claims, and in the production of most of these, science enters.

Bringing Africa to Arizona

One of the recent photoplays that used full-size sets and thousands of actors and did not, in the main, resort to trick photography of the variety that is quite familiar to all, is that known as "Beau Geste." Also, in this picture, the science of communication in its varied branches was called into play in order to enable the director to command successfully veritable armies of players.

When preparing for the picture mentioned, Herbert Brenon, director of the enterprise, set out to search for a suitable location on which to film scenes that were to depict life in a lonely fort of the French Foreign Legion located in the wastes of the Sahara Desert. He finally found such a place in a sandy stretch of country in Arizona, near the Mexican border. To this location he moved his entire staff, including several thousand extra players and an almost equal number of horses. In addition to these, there was a corps of trained electricians and signal men with equipment to meet almost any type of unusual communication conditions.

In an interview with the writer, Mr. Brenon described the chosen location in the following manner:

"After a drive of some 25 miles over a desert highway, we left the car and tramped over the sand for about four miles. Here, as we reached one of the highest dunes, we were greeted with a view which immediately made me decide that, if it was physically possible for us to do the work there, there it would be done.

"My engineers looked over the situation and said that it would be necessary to build a plank road from the highway to the site in order to provide for the transportation of supplies. This was done and soon a town sprang up in the middle of the sandy wastes, complete even to a barber shop and a hospital."

Courtesy Paramount Pictures

THE UP-TO-DATE DIRECTOR

Mr. Brenon, left, commanding the army of players spread out over the dunes and shown in the upper illustration

Aside from the building of the town to house the actors, plans had to be completed for communication. Of course, since the company was planning to remain on location for several months, it was necessary to string telephone and telegraph wires to the nearest town so that the executives could keep in touch with their home offices. These lines of communication had to be carried over the sandy hills on specially constructed poles.

Work Starts at Sunrise

Soon the preliminary work had been finished and a fort had been erected on the summit of one of the dunes. In part of the story of the picture, the fort, supposedly in the Sahara, was to be attacked by a tribe of marauding Arabs. In the picture, the parts of these tribesmen were taken by thousands of western cowboys and other expert horsemen. This multitude of players had to be scattered over the face of the desert, yet kept within the camera lines and always subject to the orders of the director. In describing this enormous task, Mr. Brenon said:

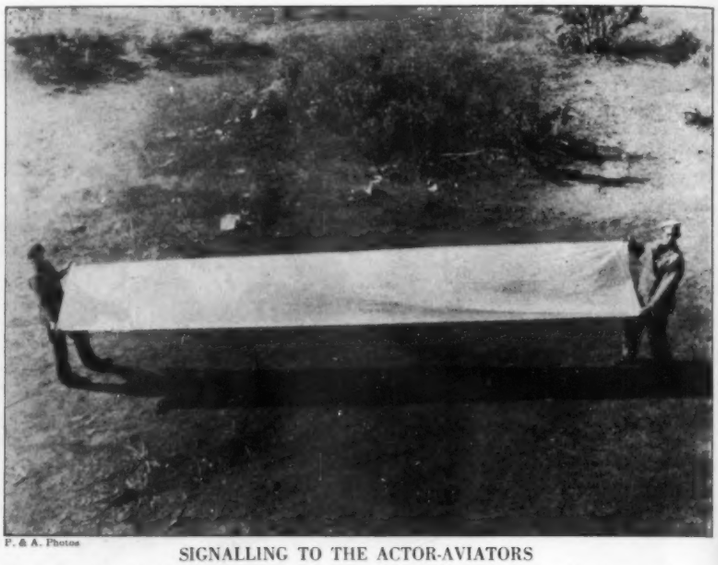
"The only times that actual photography could be carried on with success were from about seven to quarter of eight in the morning and from five to quarter of six in the afternoon. At these times, the light conditions were at their best and the shadows, so essential to successful desert photography, were neither too long or too short. Without the shadows cast by the dunes, photographs taken on the desert are flat and uninteresting.

"In order to be ready to take advantage of the short time that was available, it was necessary to have everything completely prepared so that no time would be lost when the light conditions became

P. & A. Photos

MOTION-PICTURE DIRECTING FROM AN AIRPLANE

During the filming of "Wings," part of the problem of directing the air and ground forces was met by using radio-equipped airplanes of the type shown



P. & A. Photos

SIGNALLING TO THE ACTOR-AVIATORS

The type of signal shown is called a "panel." In various forms, it is used to issue orders to the pilots, such as where to maneuver, when to dive, et cetera

right. When taking the long 'shots' of the attackers on the fort, it was often necessary to start work at sunrise. The riders would be dispatched over the desert to the approximate places that they would occupy when the action started. All day long the maneuvers would continue, until everyone was in his proper place.

"To assist me, loudspeaking telephones and field telephones of the conventional type were located at strategic points, distant from my station near the cameras. By means of these, I was able to keep in constant touch with the various units, some of them separated by a mile or more. The wires connecting the various reproducers on the desert were hidden by the irregularities of the sands. Larger dunes concealed the speakers."

In his work on the desert, Mr. Brenon also employed other signal methods. A group of trained signal-men from the United States Army were at hand and many actions were carried on to the accompaniment of the flapping of semaphore flags. The flags were of particular value in some cases, as they had the advantage of transmitting signals at all times, regardless of the amount of noise in the vicinity. Once a battle charge was started, no loudspeaking telephone could hope to compete with the cries of the "Arab" cowboys and the thuds of thousands of horses' hoofs on the sand.

On such occasions, the flag signals proved their worth. Also, it sometimes happened that, after the distant players were spread to Mr. Brenon's satisfaction, the sounds from the loudspeakers were not of sufficient volume to reach all of them. In order to eliminate any possibility of mistakes under such conditions, two large, specially made signal-flags were used. A white one was hoisted near the director's position when everything was ready for the charge. Then, as the critical moment approached, this was lowered and a red flag raised. When this dropped, the charge started and the cameras were brought into play.

Another signal system that is often used, under circumstances that allow it, is a predetermined series of pistol shots. Of course, when filming battle scenes where there is much incidental shooting, this method is robbed of some of its efficiency. However, by using black powder, the transmission of signals is effected in two ways—by the sound of the shot and by the sight of the powder smoke.

P. & A. Photos

ONE OF THE GROUND TRANSMITTERS

This is the type of semi-portable radio set that was extensively used for conveying signals to the airplanes

Temperament Necessitates Signals

All of the signal systems are not confined to outdoor productions. Some of the studios are so large and the sets are so built that some method of direction, other than that afforded by the traditional megaphone, must be resorted to. Here the loudspeaking telephones referred to above are sometimes employed. However, it occasionally happens that some unforeseen contingency makes a special system imperative.

A description of an example of this was given by one of the technical men of the Famous Players-Lasky Long Island studio. It seems that the leading man in one particular photoplay was very temperamental. One of the scenes depicting a dramatic moment just at sunrise demanded the careful manipulation of many lights in order to secure the proper effect. This was to be directed by the stage electrician through the usual process of calling out his orders to the men at the various controls. But the leading man balked. There was too much noise. It interfered with his acting and prevented him from obtaining the proper emotional effect. So the entire work was stopped and a complete signal system was installed, consisting of several groups of lights controlled from a switchboard. The lights were so arranged that they would flash the necessary signals to the various electricians, without disturbing the temperamental actor in any way. The work then proceeded to a successful finish.

In studio work of all kinds, there are various powerful lights that must be used to obtain the proper effects. The men who control these lights are often given their orders by means of whistle signals, unless it happens that one of the leading actors is temperamental as cited above.

For example, in one of the productions that the writer watched the filming of, a certain scene had to be taken several times, in order to be sure that the required results would be obtained. Because of the interval between "shots," it was necessary that the various lights be turned on and off for each trial. The set was illuminated from above by several large searchlights. These were placed on tall frame-work towers and each was attended by a man. Just before the action was to be started, a short blast from the director's whistle was the signal for each light operator to turn on the current. At the termination of the "shot," the lights were signalled off by another blast.

One of the large productions that will be released this spring is the war story called "Wings." In the filming of this historical drama, thousands of extras as well as many machines of war were used. Over 200 airplanes, numerous battle tanks, and many field and machine guns were brought into service. In order to keep all the parts of this large organization in accord at all times, a complicated signal-system was required.

P. & A. Photos

USING A FLAG SIGNAL

Camera-men in airplanes had to be given orders occasionally. This is one of the several methods used

Courtesy Paramount Pictures

THE 100-FOOT SIGNAL TOWER

Several different methods of sending orders and information to various players were concentrated on this tower

One of the first difficulties that the directors had to overcome was the handling of the many airplanes, especially when these were to be filmed at the same time that action on the ground was shown. To keep the planes within the camera lines was a problem that was finally solved by the use of radio. Powerful short-wave transmitting sets were located on the ground. These communicated with the pilots of the various planes, giving them the orders which, when executed, would produce the best photographic effect.

The story of "Wings" works up to a climax in the battle of St. Mihiel. In order to produce this with proper regard to the facts of the original engagement, over 6,000 men and 100 airplanes were employed, "battling" over an area of five square miles. Obviously such a large company could not be directed with any of the usual methods and so the engineering section set to work.

They erected a framework tower 100 feet high. At the top was a platform for signal men who communicated with various parts of the battle area by means of semaphore signal-flags. Twenty-five feet below these men, a complete radio broadcasting station was installed. This was for communication with the airplanes, each of which was equipped with a sensitive receiving set. A battery of ten loudspeakers was placed on this same level. These faced the battle area and served to direct those players who were in the immediate vicinity.

Courtesy Paramount Pictures

A DESERT TELEPHONE LINE

Special communication lines to nearby towns were run across the desert, supported on poles of this unusual type

A switchboard for the vast system of field telephones was placed on a platform at the 50-foot level. This controlled the 72 telephones that had been placed in various parts of the field. An emergency system of light-signals was located at the base of the tower, to be used in case trouble developed with the radio apparatus.

Filming a Town During Bombardment

An interesting phase of photography entered into the making of this war picture. The "script" called for scenes in a village under bombardment. The filming of such action is often fraught with danger for the camera-men. To eliminate this, electrically controlled and driven cameras were designed. Several of these were located in the village that was to be destroyed. The cameras were buried in the ground or protected in other ways so that they would not be damaged by the flying debris. Only the lenses were allowed to project and these were protected as much as possible. When the bombardment of the town started, there was not a camera-man in the vicinity, yet the finished film was as perfect as could possibly be obtained by any method.

Courtesy Paramount Pictures

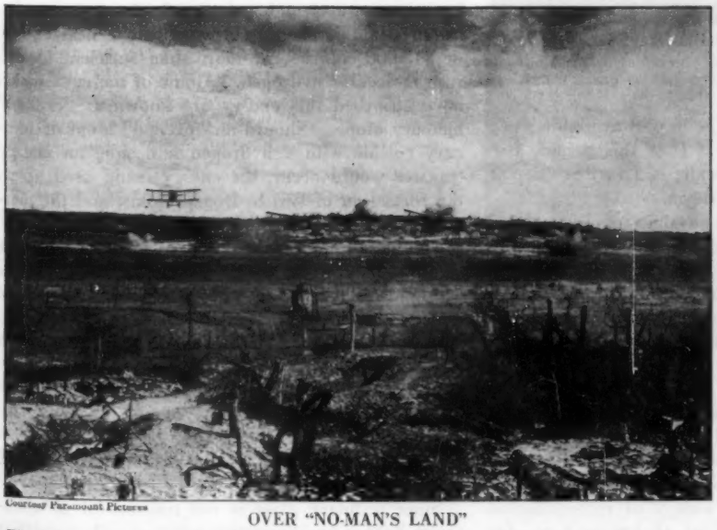
CONTROLLING AN AUTOMATIC CAMERA

The box in the foreground contains the batteries that actuate the motor which "cranks" the distant camera

The illustration directly above shows the control end of the camera system just mentioned. In the box on the ground are the storage batteries that furnish the current for operating the electric motor on the camera. The operator is kneeling beside the box and need only press a switch to start or stop the camera. He thus has as good control of the filming operation as if he were turning the crank of an ordinary hand-driven camera. This new type of camera is coming into wide use, not only out-of-doors, but also in the studio where absolute accuracy in cranking is necessary.

One of the directors is standing beside the camera-man in the illustration mentioned. He has a telephone set that enables him to communicate with various points throughout the "battle area." He need only plug in on a convenient line in order to be in immediate contact with the other directors as well as with the camera-men located at distant points and the base of all operations—the signal tower.

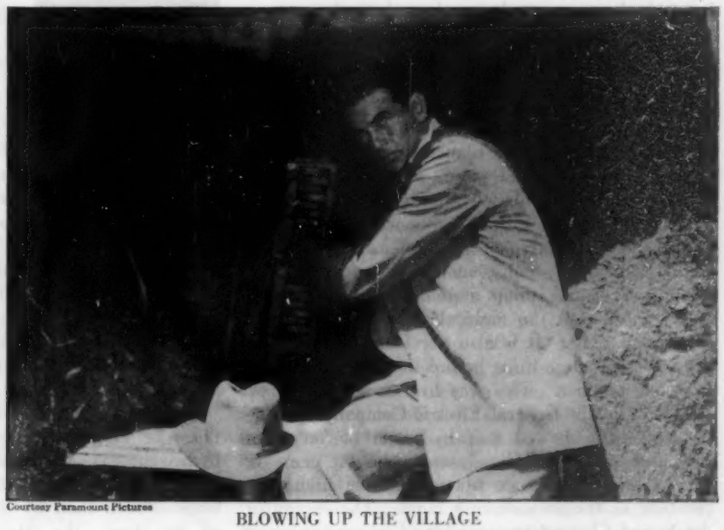
So we see that the motion picture producers are turning to science for help and are making good use of the advancements in its various branches.



Courtesy Paramount Pictures

OVER "NO-MAN'S LAND"

The infantry attacks, tanks advance and airplanes dart back and forth overhead, all for the faithful depiction of battle scenes for the motion picture "Wings"



Courtesy Paramount Pictures

BLOWING UP THE VILLAGE

The masses of explosives, placed in the village so as to give the effects of exploding shells, were set off from distant, sheltered points such as this one

The Simplest Element of All

Recent Research on the Atom of Hydrogen Points to the Possibility of Creating a New Chemistry Richer in Potentialities than the Chemistry of Today—the Chemistry of Atomic Synthesis

By Hugh S. Taylor
Professor of Physical Chemistry, Princeton University

THE chemist is busy with a new toy. This time his plaything is the atom of hydrogen. As the small boy is initiated into the lore of chemistry with experiments on molecular hydrogen, producing with delight, sometimes with disaster, sonorous explosions, so the trained chemists in Berkeley and Berlin, in Pasadena and Princeton are today turning their investigations to the properties of the atom of the same species, with results rich in suggestiveness and application.

Atomic hydrogen is not a new product; it is however, newly recognized. The substance is made familiar to the student of general chemistry in that non-committal phrase, "nascent hydrogen." For, it was early recognized that hydrogen at birth possessed properties which it ceased to possess after birth. By isolating atoms of hydrogen and studying their properties, the chemist has shown that these properties are those of nascent hydrogen.

When first born, hydrogen is generally in the atomic condition. The atoms twin with one another to form molecules of hydrogen, and this is the molecular product with which everyone is familiar, which is used for the filling of toy balloons and dirigibles, and in a number of important industrial enterprises. It has a bad reputation both in aeronautics and industry because of its inflammability; the dirigible airship in flames, and explosions of gas can both be traced to the reactivity of ordinary hydrogen, its combustibility in air. Compared with atomic hydrogen, however, molecular hydrogen is tame and unreactive.

". . . Like a Planet Around a Sun"

The dictionary states that the word "protyle" (from the Greek, πρωτος, protos, meaning first or primary and υλη, ule, meaning stuff or material) is a "hypothetical primordial substance supposedly differentiated into what are recognized as distinct chemical elements." To the chemist the hydrogen atom is the protyle; it is his primordial substance, but it is, however, no longer hypothetical.

To the physicist, on the contrary, the protyle is subdivisible. The modern theory of atomic structure assigns to the hydrogen atom a single proton or unit charge of positive electricity and a single negative electron which describes an orbital path around the proton like a planet around a sun. The physicist represents the atom as in Figure 1, in which several possible electron orbits around the proton are shown. With such a concept, the spectroscopic and electrical properties of atomic hydrogen can be successfully represented and forecast.

To produce and isolate atomic hydrogen it is necessary to disrupt the molecules, to tear apart the constituent units. It is also necessary to study the properties of these units before they can recombine with one another. This was first accomplished by Langmuir of the General Electric Company at Schenectady, who showed that hydrogen at very low pressures dissociated into atoms when it came in contact with a tungsten filament at the high temperature of the incandescent lamp. The energy of the heated filament was consumed in tearing apart the molecule. The low pressure reduced the number of collisions between the atoms so formed and enabled Langmuir to show that they possessed remarkable properties. They clung tenaciously to the glass walls of the containing vessel wherever they struck, thereby reducing the gas pressure in the vessel. Their reactivity as compared with ordinary molecular hydrogen was revealed in the ease with which they reduced oxides to metals. Thus, black oxide of copper was transformed at ordinary temperatures to the bright lustrous red metal, a reduction for which a temperature of hundreds of degrees is required with molecular hydrogen.

Langmuir was able to calculate that it required the input of 100,000 calories of energy to bring about the dissociation of two grams of hydrogen molecules into the constituent atoms. Did the dissociation into atoms not occur, this energy would suffice to raise the temperature of the gas to 20,000 degrees, Centigrade (36,000 degrees, Fahrenheit), a temperature about four times greater than that of the sun. This same energy is in part available when hydrogen atoms recombine. How this became feasible, even on a practical scale, is a further chapter in the story of atomic hydrogen.

DR. TAYLOR AND HIS LAMP
This simple type of lamp is very suitable for the study of atomic hydrogen. The center part is quartz glass

Professor R. W. Wood, physicist of Johns Hopkins University, showed that, in an electric current of sufficient potential and concentration, there resides the energy necessary to tear apart the two hydrogen atoms of ordinary molecular hydrogen gas. In his experiments, electric discharges were passed through hydrogen at low pressures and the atoms were removed from the discharge tube by vacuum pumps.

Langmuir and his associates have shown, however, that the discharge may be sent through jets of hydrogen gas at ordinary atmospheric pressure. Hydrogen atoms may thus be obtained in concentrations such that, by the energy of recombination of the atoms, the attainment of temperatures far beyond those available with the oxy-acetylene flame, rivalling even those of the electric torch, is readily accomplished. A new welding tool has been produced. Flames of atomic hydrogen are now at the disposal of the metal worker. The most refractory metals yield to the new welding process and the industrial applications are already numerous. The process has especial advantages in that the flame is free from carbon, which is an objectionable constituent in many metal-welding operations.

Yet another method of reaching the hydrogen molecule with the energy necessary for its disruption has been devised by the physicist, a method of particular interest to the chemist in that, by its aid, cold hydrogen atoms may be produced under conditions which favor a study of their chemical properties. The device which is used to supply the large amount of energy necessary to disrupt the molecule without increasing the temperature, is to make use of light energy.

The modern developments in the theory of light, based upon the so-called "quantum theory," teach that light consists of bundles or "quanta" of energy, each bundle of a certain color corresponding to a known and definite amount of energy. Thus, the light given out by a flame, colored yellow with ordinary common salt, the D sodium line, corresponds to an energy of 48,000 calories. The 100,000 calories of energy necessary to break up hydrogen molecules into atoms corresponds to light in the ultra-violet, beyond the visible range, of a wavelength which the physicist states as approximately 2,600 units.

Quartz Glass Necessary

Hydrogen, however, does not absorb such light. It therefore became necessary to find a substance which would absorb such light and transmit it to hydrogen. Two German physicists, Franck and Cario, found such an agent in mercury vapor. This gas, when present even in the minute amount of 1 part in 10,000 of a gas mixture, will absorb completely the light emitted by a cooled mercury arc having a wavelength of 2,537 Angström units. Bundles of this energy correspond to a heat energy of 112,000 calories, or more than sufficient to disrupt molecular hydrogen. Atoms of mercury which have absorbed this energy are known as "excited" mercury atoms. Should an "excited" atom of mercury collide with a hydrogen molecule, an energy transfer would occur, the energy being used up in the formation of two hydrogen atoms, and the mercury atom relaxing into its normal state.

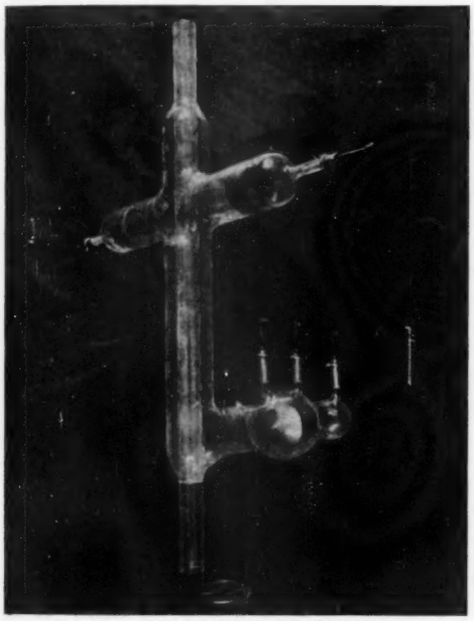
The whole process is analogous to the mechanism whereby a lead shot in a sporting cartridge is endowed with sufficient velocity to shiver to pieces a clay pigeon. The atom of mercury is the shot. The light energy which it absorbs is equivalent to the energy supplied by the percussion cap, the hydrogen molecule is the clay pigeon and the hydrogen atoms are the remnants of the process. By utilizing light energy, all this remarkable exhibition of atomic energy can be achieved in a vessel cooled in ice water.

Since ordinary glass is not transparent to ultraviolet light it has been necessary not only to utilize sources of light energy in apparatus of quartz but

also to develop suitable containers of quartz in which the atomic encounters may be achieved. Some beautiful examples of such quartz lamps and reaction vessels are shown in the accompanying illustrations. They have been built by quartz glass makers in this country from designs made in Princeton University and probably represent the high-water mark of quartz glass technique yet achieved.

The chemist has taken up the story where the physicist laid it down. By mixing other gases with the hydrogen and mercury it has been possible to ascertain what the subsequent history of the hydrogen atoms is. Experiments in Princeton showed that, if these atoms collided with oxygen, the first product to be formed was not water, but hydrogen peroxide, the substance well known in 3 percent solution as a disinfectant and also as an industrial bleaching agent. By this method the peroxide could be produced 100 percent pure without any trace of water.

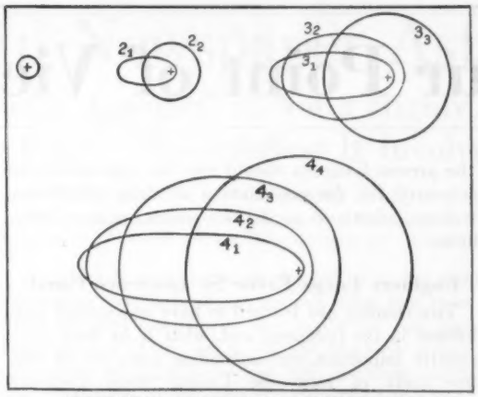
This simple experiment at once made clear the mechanism of two old experiments in which hydrogen peroxide is formed. It has long been known that when an oxy-hydrogen flame was allowed to play on a block of ice a little hydrogen peroxide is formed. The new work indicates that, in the flame, there are present small amounts of atomic hydrogen which react with oxygen to form the peroxide which is stabilized as such on the ice surface. The ice serves to cool the peroxide rapidly from the flame temperature and thus to maintain it undecomposed.



HOW THE LIGHT IS PRODUCED

FIGURE 2: *The light from the arc produced in this powerful lamp is absorbed by mercury atoms in a stream of hydrogen flowing through the central tube of the lamp, giving rise to atomic hydrogen in the gas stream*

Similarly, when hydrogen is generated by passing an electric current through a solution of sulphuric acid it has also been found that hydrogen peroxide may be produced by allowing oxygen gas to bubble over the electrode at which the hydrogen is being generated. Hydrogen exists in sulphuric acid solutions as hydrogen ions—the proton of our first diagram. The electric current consists of electrons passing through the conductor to the electrode, at which, therefore, proton and electron unite to form an atom. In the absence of oxygen these atoms accumulate and, by twinning, gradually form molecules and are evolved as such.



HYDROGEN PROTON AND ELECTRONS

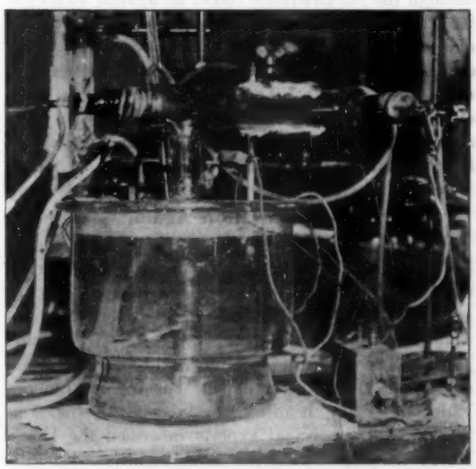
FIGURE 1: *This represents the concept of the physicist, the electrons of the atom being in constant revolution about the nucleus. This concept seems to agree best with experimental evidence. Chemists are now adapting this idea to their own chemical problems*

But, if the electrode be kept bathed in oxygen gas, the alternative reaction of the atoms with oxygen to form peroxide becomes possible and demonstrable. Two German investigators showed that high pressures of oxygen gas favored the reaction at the electrode surface. Practically quantitative utilization of the electrical energy consumed in the production of the hydrogen was secured and peroxide solutions of medium strength were produced. Their experimental work was carried out, however, before the era of industrial syntheses at elevated pressures, and led to no practical results.

It is possible, however, that a re-examination of this problem may lead to commercial developments of importance, since hydrogen peroxide is one of the most suitable bleaching agents. It owes its value to the fact that it decomposes to water during the bleaching process, so that no harmful ingredients are left in the article bleached.

Formaldehyde by Synthesis

It has also been shown in Princeton that two hydrogen atoms will add on to carbon monoxide, the resulting product being formaldehyde, the important raw material of bakelite and such synthetic resins. The synthesis of formaldehyde from carbon monoxide and hydrogen atoms, as well as many other reactions of hydrogen atoms now studied, indicate that the extraordinary activity of metals as agents for accelerating chemical reactions is to be ascribed to the presence of hydrogen atoms on the surfaces of such metals when they are brought in contact with molecular hydrogen. It is the attraction of the metal atoms for the separate atoms of the hydrogen molecule which, in this case, causes the dissociation of the hydrogen into atoms and, hence, the extraordinary activity of such metal-hydrogen systems.

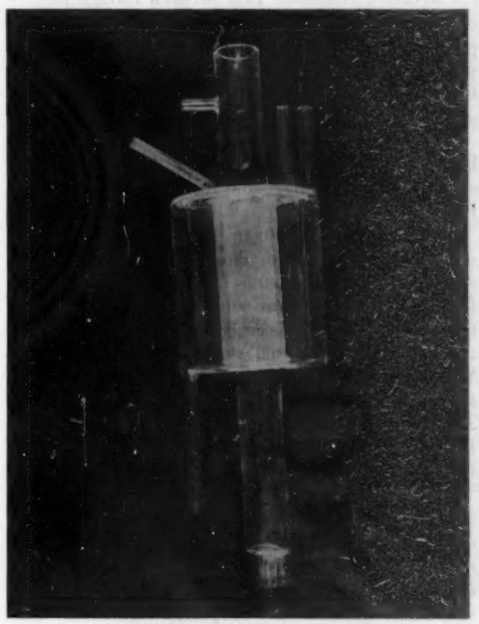


ARC SYSTEM READY FOR USE

The lower part of the arc system stands in a water bath whose temperature controls the mercury-vapor pressure. The high-tension spark coil used to start the arc is a Ford coil. It is shown at the right

It is on the basis of this attractive force that many important industrial achievements are built, for example, the combination of nitrogen and hydrogen to form ammonia, and the addition of hydrogen to liquid vegetable fats to make of them hard vegetable fats suitable as lard substitutes.

We have clothed our ignorance of such processes by grouping them together under the high-sounding if somewhat meaningless title of catalysis. Here again, however, can be exemplified the universal experience in science, the illumination of what is dark and little understood in one field by the increase of knowledge in other, if cognate, fields. The study of the properties of hydrogen atoms has led to the positive identification of hydrogen atoms on metallic surfaces.



ANOTHER QUARTZ ARC-LAMP

FIGURE 3: *The lamp consists of four separate compartments, the center one for the purpose of carrying a mercury arc. The outside chamber is the reaction system. The inner compartments form filters for light and heat*

The evidence thus obtained points to the presence of hydrogen atoms in metals saturated with hydrogen gas. The speed with which hydrogen passes through massive metals such as palladium and iron even suggests that the process of disruption may be even more complete and that, within the metal, hydrogen may be present not only as atoms but also as protons and electrons.

What a fascinating possibility this thought inspires! For, there at hand, within the metal, would be the unit bricks from which the atomic architecture may be constructed. The nucleus of helium is, most probably, composed of four protons and two electrons.

Is it of the achievement of this synthesis of an atomic nucleus that recent reports of work by Professor Paneth of Berlin would tell? If so, the broad highway has been indicated to a domain yet richer in potentialities than the chemistry of the present and the past.

The new chemistry would be the chemistry of atomic synthesis. Man's control over matter would be well-nigh complete.

Our Point of View

Much Ado About Nothing

SO far as naval affairs are concerned, the people of this country, and, with a few exceptions, their congressmen, are entirely at the mercy of the naval propagandist. Only the man who has made a close study of the naval problem is able to determine for himself what is the relative strength and efficiency of his own as compared with other navies. The journalist, whether he be "cub reporter" or full-blown "special writer," is guided on his course by what the naval specialist may happen to tell him. If the truth is put before him, well and good; if not, he may prove to be the first sheep that jumps the fence and leads the whole flock into error.

To get down to concrete facts, take the case of the so-called armament race between foreign powers in the building of light cruisers, which has been so persistently dinned in the ears of the public, that probably 99 out of 100 good American citizens believe that since the war such a race has been going on.

As a matter of fact, since the treaty there never has been any such competition; there is not any such competition today; and there are no indications that there ever will be.

That there is a shortage of light cruisers in our navy, as compared with those of the other leading signers of the Washington Treaty, is not due to the fact that Great Britain and Japan are feverishly building up their cruiser fleets; it is explained by the fact that, in the ten years preceding the Great War, our Navy Department was so obsessed with the battleship, that from 1904 to 1914 it expended almost all the available funds for new construction in building battleships, and practically none of it for light cruisers.

Great Britain and Japan, who are supposed to be the principal offenders in this so-called cruiser race, distributed their naval appropriations in a carefully determined proportion between battleships; battle cruisers, fast cruisers, et cetera, so as to maintain a well-balanced fleet. Every year, because the older ships were growing obsolete, a few new cruisers were laid down. At the Washington conference the three leading naval powers wished to have the 5-5-3 ratio applied to all types of fighting ships, and had it not been for the opposition of the continental nations, this would have been done. As it was, the treaty affected only capital ships and aircraft carriers. Hence, today, in spite of our having built, since the War, the ten very fine and fast cruisers of the *Omaha* class, we find ourselves possessed of a light cruiser fleet that is out of proportion to our battleship fleet—its strength being below the desirable ratio. Great Britain and Japan, due to their policy of maintaining a light cruiser fleet proportionate to their battleship fleet, are stronger in light cruisers than we are.

The new cruiser construction of these powers is to take the place of the obsolete or obsolescent ships at the bottom of the list. This policy is perfectly legitimate and does not violate the principles of the Washington Treaty, either technically or morally. Hence, instead of crying "Wolf, Wolf!" about a peril which does not exist, we should set ourselves to the proper balancing of our navy by building additional treaty cruisers until we have reached the proper proportion. There would be no threat to other peoples, and such a policy would be perfectly understood by Great Britain and Japan. The present Congress should vote the appropriations necessary for the construction of three 10,000-ton cruisers, additional to the two which are now being built.

Engineer Corps Favor St. Lawrence Canal

THE country has learned to have unbounded confidence in the judgment and, what is in these days equally important, the unbending integrity of that fine body of men—the United States Engineer Corps. Confronted with great national problems of constructive engineering, as in the case of the Panama Canal, the improvement of the Mississippi and similar problems, their decisions have ever been justified by the results. Recently, forming part of the Joint Board of Engineers on the St. Lawrence Waterway Project, they have gone on record as favoring that route from the Great Lakes to the sea in preference to any other. In a later issue, we shall discuss this, the greatest engineering problem confronting the United States, in full detail. Just here, we can do no more than give the salient features of the engineers' recommendations. Thus, as compared with the proposed canal across New York State, the St. Lawrence route requires only nine locks as against 20, and eight bridges as against 24. On the St. Lawrence there will be 25 miles of restricted navigation; on the State Canal 128 miles. Secretary Hoover estimates that maintenance and interest charges will be only 43 cents per ton on freight through the St. Lawrence route, as against $1.64 for the other route. Lastly, if the matter of power development is left to state or private initiative, the cost to the American and Canadian governments of opening up the St. Lawrence Waterway will be under $150,000,000, whereas the cost for a ship canal across New York State and down the Hudson River will be $506,000,000.

Secretary Wilbur Before the House Naval Committee

"I have absolutely no sympathy with the claim that we were outgeneraled in that limitation of armaments treaty. The fact is that we got exactly what we proposed, and I am perfectly willing to accept the judgment of those who participated in that treaty that the battleship strength, at the conclusion of the treaty and of the scrapping, was substantially in the ratio stated in the treaty."

Gun Elevation Again

As an instance of the same class of misleading propaganda as that regarding cruiser construction, we quote the statement, so frequently made, that the guns of our treaty battleship fleet are greatly outranged by those of the fleets of Great Britain and Japan. The following is from the *New York Times* of January 14th. It is dated, Washington, January 13th, under the heading of "Special to the *New York Times*." "Naval experts informed the House Naval Committee that the modernization of battleships as recommended should include elevation of guns, as our present range is approximately 17,000 yards, while the range of the British and Japanese guns runs to about 30,000 yards."

Now, if the above paragraph is to be taken at its face value, it means that these "naval experts"—whoever they may be—endeavored to persuade the House Naval Committee that the range of the British and Japanese guns is not so very far from twice as great as the range of our guns!

If the above statement be true, it would mean that the British fleet could stand off beyond the range of our guns and pound our ships to pieces at its leisure. Moreover, our naval experts at the Washington Treaty must have been woefully hoodwinked—which that small section of our naval officers which was opposed, and still is, to the Washington Treaty, would have us believe is exactly what happened. Happily, not only is this untrue, but it is a most reprehensible misstatement of the facts and a deliberate misleading both of the people and their congress. There could be no higher authority on such a subject, surely, than the Secretary of the Navy himself, and in order to silence once and forever such propaganda, the Secretary made the statement which is reproduced in the panel in the center of this page.

During the 1925 agitation of this question of ranges, the Navy Department was asked to present to the Naval Committee an exact statement of the ranges of the battleship guns, both of our own and the British Navy. We publish these official tables on page 196 of the present issue. Study them and you will find that so far from the foreign ships outranging our own, the five latest and most formidable of our ships outrange the latest and most effective battleships of the British fleet by from 10,200 to 11,400 yards; our next three would be outranged by 300 yards at 24,000 yards range; that the next ship in line, *Arkansas* would have 50 yards advantage of the opposite British ship; that the next ship *Wyoming* would be outranged by 800 yards, and the last eight of our ships would be outranged by the opposing ships by from 1,800 to 2,800 yards.

Now, what do these figures mean? Let us interpret them in terms of a great sea battle. In an engagement between the fleets, the two lines of battle would converge until the guns of both fleets were within hitting distance of the enemy. Now, since the guns of our "big five" are shown by our Navy's own official figures to have an advantage of range of over two miles over the British guns, it follows that for the first half hour or more of the engagement, or during the time that the British were drawing in close enough to hit our ships, the head of their line would be exposed to a most devastating fire from the 14-inch and 16-inch guns of our ships, to which they could make no reply whatever. This means that if our gunners can shoot as well in battle as they are doing today in target practice, the head of the British line would be crumpled up before it got into action. With the head of their line gone, the advantage of range of from 1,800 to 2,800 yards of their older ships would never avail them to turn the tide of battle.

Again, it is the claim of the naval propagandists that we should elevate our guns in order to bring about equality. As a matter of fact, if we elevated all our guns to 30 degrees, our whole fleet would have an excess of range over the British fleet of from a minimum of 6,200 yards to a maximum of 11,400 yards. This would mean that the whole British line would be under our fire from 20 to 30 minutes before any one of its ships could hit our line.

Doubtful Newspaper Astronomy

The Phenomenon Known as "Lunar Appulse" Is Not a Highly Rare Astronomical Event, as Was Recently Announced by the Press. Nevertheless It Involves Interesting Considerations

By Henry Norris Russell, Ph.D.

Professor of Astronomy at Princeton University
Research Associate of the Mt. Wilson Observatory of the Carnegie Institution

A FEW weeks before these words were written there was considerable popular discussion regarding a "lunar appulse" which occurred on December 19, 1926, and statements found wide currency that it was a very rare phenomenon, which happened only once in several centuries.

If this were true, it might naturally be inquired why astronomers paid no more attention to such an unusual affair; but, as a matter of fact, the event was an unexciting and rather commonplace one, and so it excited no comment among those who understood its meaning.

The term "lunar appulse" is employed to describe a case in which the moon barely escapes a partial eclipse. It is a particular case of the more general "penumbral eclipse of the moon" in which our satellite suffers some loss of light from the partial interposition of the earth between it and the sun.

Such near eclipses are far from rare; they happen almost every year, and there were actually four of them, of greater or less extent, in 1926. Although most of them are accompanied by nothing that could be detected except by an observer equipped with a good photometer, they are of some interest, as examples of elementary astronomical theory.

Figuring It All Out

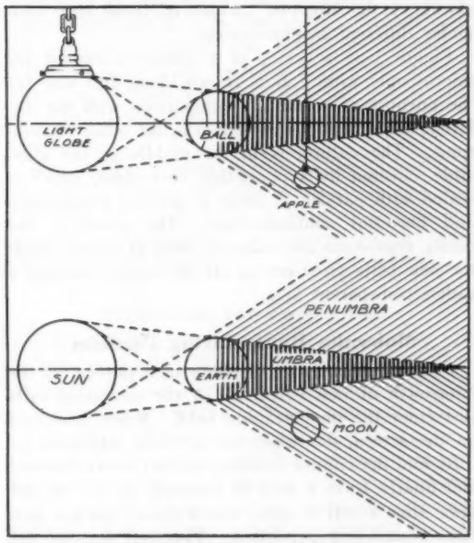
Every one knows that at the time of a lunar eclipse the earth's shadow falls upon the moon and darkens it; and almost every one realizes that, since the sun is a large luminous body, and not a mere speck of light, this dark shadow is surrounded by a partially darkened border, the penumbra. Such a "twilight zone" on the edge of a shadow is, indeed, a matter of familiar experience.

When the sun is low, and the shadows extend to a considerable distance, we are all familiar with the fact that the edge of a shadow looks sharp only when the object which casts it is close by. For a more distant object, such as a house a few hundred feet away, one who is walking into the shadow will not enter it abruptly. As he watches the sun, he will see it disappear gradually, behind the edge of the house—first one side of the disk, then the middle, and finally the last trace. If beside him there is a wall upon which the shadow is cast and made visible, he will notice that its boundary is decidedly hazy. At the outer edge of the penumbra, when as he looks at the sun only a small slice of it is hidden, the change in the illumination on the wall will be quite imperceptible, but as the inner edge is approached, when all the light is cut off, the darkening becomes conspicuous.

The width of the penumbra, in the case of sunlight, is 1/109 of the distance of the object which casts the shadow (since the diameter of the sun is 1/109 of the sun's distance). Even at a distance of six or eight feet, the shadows of the separate fingers of the hand become very diffuse. The penumbra spreads inward until the central dark shadow is quite eaten up, while at the same time its outer boundary spreads outward, so that the faint and hazy shadow is wider than the finger itself. Just the same thing happens, although not to so complete a degree, in the case of the shadow cast into the depths of space behind the earth itself.

Could a huge white screen be set up in the right direction, just beyond the moon's orbit and therefore 240,000 miles away, we should see cast upon it a shadow of the earth. If the sun were a mere luminous point, this shadow, like the earth, would be 7,900 miles in diameter (to the nearest hundred), but at this distance it would have a hazy penumbral zone at the edge, with a width of 1/109 of 240,000 miles—which is very nearly 2,200 miles. The boundary of the dark central shadow would thus be set inward 1,100 miles on all sides, leaving it but 5,700 miles across, while the extreme outer edge of the partially shaded region would be equally extended, making its diameter 10,100 miles or nearly twice as great.

The center of this shadow would appear to be at the point of the heavens which is exactly opposite the sun, and in the plane of the earth's orbit—the ecliptic. If the moon moved in this plane, it would



A HOME-MADE APPULSE

The drawing explains itself. Moon and apple should, however, have been placed a little nearer to the umbra

pass through the shadow and be eclipsed at every full moon; but its orbit is inclined a little more than five degrees, which means that it oscillates across the plane of the ecliptic, sometimes getting more than 2,100 miles above it, and sometimes as far below. At most full moons, therefore, the moon is far too high or too low to get into the shadow—she escapes it entirely. If, however, at the time of full moon she is within 2,850 miles of the plane of the ecliptic, her center will dip into the shadow and she will be at least half eclipsed.

The moon's diameter is 2,160 miles and her radius 1,080, hence if her center is within 1,770 miles above or below the plane (2,850 minus 1,080) she will be entirely immersed in the shadow, and will be totally eclipsed. If her distance from the ecliptic plane is between 1,770 and 3,930 miles, she will be partially immersed in the shadow; if still further away, she would pass only through the penumbra; but to get entirely clear of the latter she must be at least 6,130 miles up or down.

It is evident from these figures that a total lunar eclipse will happen only when the moon, at the moment of the full, is pretty near her node—the point when her path crosses the ecliptic. A less close agreement of the two will give us a partial eclipse, and one still more imperfect, a penumbral eclipse only.

It appears also that eclipses of these sorts should be about equally numerous, and this is actually the case. During the last saros (the period of 18 years and 11 days, after which eclipses repeat themselves under almost identical conditions, except with regard to the part of the earth from which they are visible) from 1909 to 1926, inclusive, there were 14 total eclipses of the moon, 13 partial eclipses, and 15 "penumbral eclipses." These figures are taken from an excellent paper by M. Blum in *L'Astronomie* for January, 1926, to which those who read French may be referred for details.

For inhabitants of the moon, if there were any, these penumbral eclipses would be counted as partial eclipses of the sun, visible from parts of the moon surface, but usually not from the whole sunlit hemisphere, and in which the sun was never completely hidden behind the earth. All that the terrestrial observer can notice is that the edge of the moon which dips into the shadow appears somewhat diminished in brightness.

One Need Not Wait a Lifetime

At the recent appulse, the moon almost grazed the true shadow, missing it by less than fifty miles of actual distance, and more than 95 percent of the sun's light was cut off from the edge of the moon which so narrowly escaped eclipse. Even the opposite limb was immersed in the penumbra, although to so small a depth that but a few percent of her sunlight was cut off, and no perceptible effect could be produced.

In a case like this, the peculiar appearance of the moon would be perceptible almost at a glance. In most of the penumbral eclipses, however, the loss of light is much less conspicuous, and nothing short of careful measures would reveal it.

The term "appulse" is restricted to those instances where the approach to the true shadow is very close, and the moon is entirely immersed in the penumbra.

Such events are less common, but by no means as rare as has been stated recently, for they are repeated at intervals of a saros for several successive returns. On December 7, 1908 a still closer appulse occurred—the moon missing the shadow by less than 20 miles; and a third, not quite so close as the other two will happen in February, 1944. For four or five of the other fourteen penumbral eclipses of the last saros, the darkening of the northern or southern limb should have been easy enough to see.

One need not wait for such an event, however, to see just what it looks like, for shortly before any ordinary lunar eclipse, the moon is similarly immersed in the penumbra, and exactly the same sort of darkening toward one side may be observed with the added interest of the eclipse to follow—and it occurs again just after the eclipse is over. We need not wait longer than until June, therefore, to see just what the appulse looked like, if we missed it when it happened before.

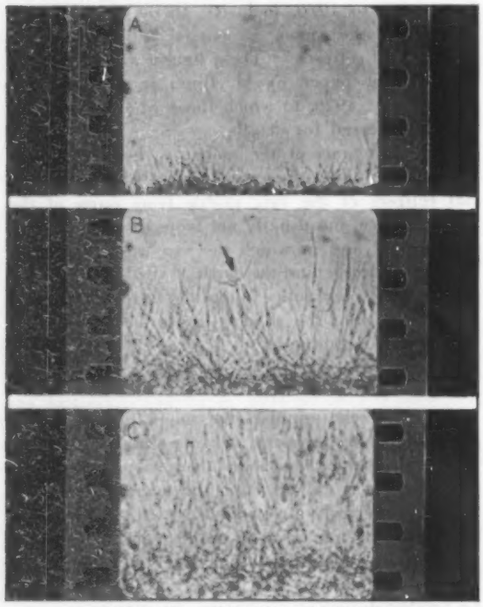
Micro Motion-Pictures

How Microscopic Cell Life Is Being Studied on the Motion Picture Screen

By Heinz Rosenberger
The Rockefeller Institute for Medical Research, New York

SINCE its invention, 30 years ago, cinematography has developed in this country from a scientific toy into an industry second only to the automobile industry. The major portion of the films produced is, however, for the purpose of entertainment; the minor is represented by educational and scientific films. Workers in science have now begun to recognize the possibility of the motion picture as an added tool in research work.

By means of our control of the time factor, conferred by cinematography, either with slow-motion or time-lapse pictures, we have been able to analyze movement and actions which our eyes could not possibly see, because they are too fast or too slow. Another feature, still to be developed and of great value to science, is micro-cinematography. Previously it has not been feasible to demonstrate the behavior of animated microscopic objects to an audience by means of the microscope alone. But the combination of microscope and cinema has rendered it possible to project films of the invisibly minute which open the door to another world.

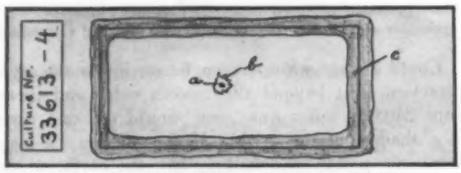


PART OF A FAMOUS CULTURE

FIGURE 2: *In 1912, Dr. Carrel started the chicken embryo culture from which this was taken. It is still thriving*

The micro-film is an asset not only for demonstration but as an aid to research work in different fields, especially where actions under the microscope take place so slowly that they cannot be observed by the eye. In such cases the micro-film is used to record positions at certain time intervals, by taking single exposures on the film. Later, these are projected on the screen at normal speed, that is, at the rate of 16 pictures per second. Thus, the motions are accelerated on the screen, so that we are able to see within a few minutes actions which take place during hours or days (so-called "time-lapse" pictures).

For three years this method has been employed by Dr. Alexis Carrel of The Rockefeller Institute for Medical Research, in cooperation with Dr. Albert H. Ebeling and the author, in the study of



READY FOR MOTION PICTURE WORK

FIGURE 1: *The tiny culture lies in the center, a being the original tissue, b the new cells after ten hours' incubation, and c the sealed cover glass*

living cells, especially those from tissues and the blood of animals. As is known, Dr. Carrel and his associates were the first to succeed in actually cultivating different animal tissues outside of the body for long periods of time in specially prepared media. For example, a strain of cells derived from a chick embryo heart is still living and has grown for many generations since 1912 when it was first started. The illustrations which accompany this article are portions of a continuous micro-film which shows us the life and actions of those tiny cells under different magnifications.

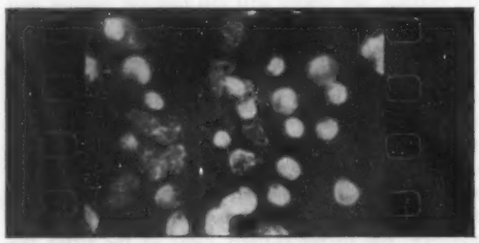
Figure 1 is a sketch of a culture prepared for microscopic work. It is shown about full size for the purpose of permitting comparison with the different magnifications presented in the other illustrations. The culture is in the middle of the glass slide, covered by a paper-thin coverglass, which is sealed with paraffin in order to prevent evaporation and bacterial contamination. The point in the center represents the original piece of tissue, while the new cells grow out in all directions, forming a rather transparent area.

Molecules Bump Living Particles

Figure 2 shows the periphery of a portion of the outgrowth of new cells. At A the migrating cells just enter the photographic field. When projected on the screen, one observes the slow migration of cells into the culture medium, as they move forward and finally form a sort of network, B, C. At the same time a cell is seen, which shows quicker motions resembling pulsations. This cell shrinks and dies and other cells grow over it.

At higher magnification, as shown in Figure 3, A, B and C, one can clearly see the agile motion of numerous granules moving back and forth and streaming in the little channels connecting cells; the nucleus can be seen in different parts.

The highest powers so far possible can be obtained by the use of high-power, oil-immersion lenses in combination with ultra-microscopic condensers. Under these conditions one can see the individual motion of the cell granules, and also the so-called "Brownian movement" of the smallest particles in the cells. This motion is of molecular origin.

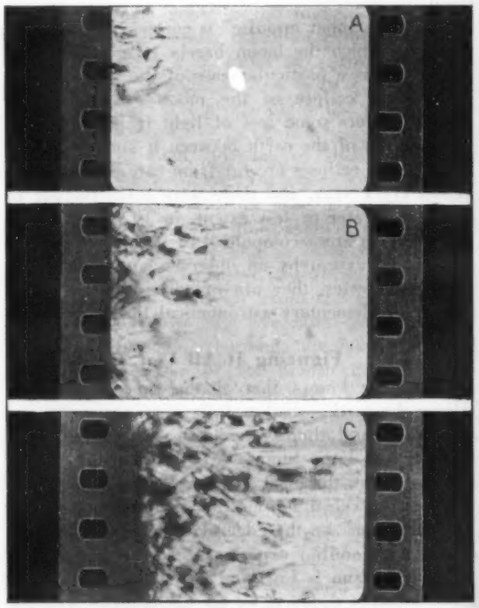


WHITE BLOOD CORPUSCLES

FIGURE 4: *This picture was clipped from a motion-picture film. Magnified 600 diameters. Dark field illumination*

The higher the magnification, the more difficult, from the optical and photographic point of view, are the problems of taking micro-films. The main difficulties encountered are the limitations of the resolving power of the objectives, the focusing with high-powered lenses with their short-range depth of focus —also the reproduction of the fine details on the comparatively rough emulsion of the film, and the determination of the amount of light necessary to obtain a photographic impression on the film.

Figure 4 is a picture of the so-called "wandering cells." These are amoeboid cells contained in the blood. On the picture screen one can clearly see the amoeboid motion of these cells—in this case white blood corpuscles—which send out pseudopods, and slowly move about by means of them. The differences between the mode of locomotion of polymorphonuclear leucocytes and lymphocytes are marked.



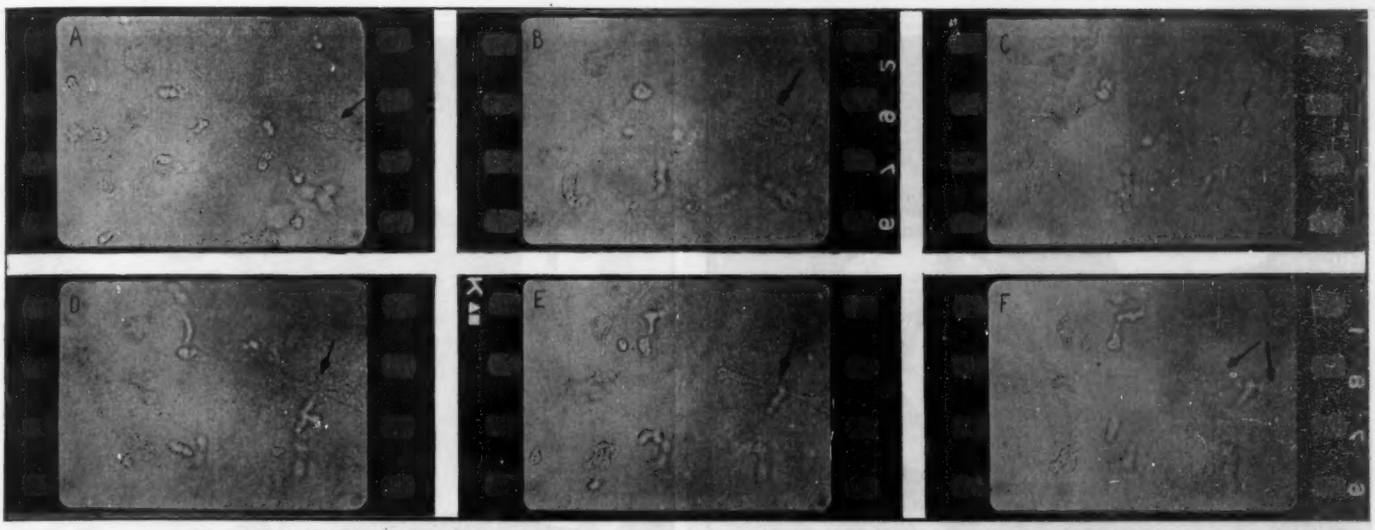
MAGNIFIED 200 DIAMETERS

FIGURE 3: *The culture of Figure 2, more highly magnified. It also proved possible to magnify up to 600 diameters*

Occasionally we have succeeded in obtaining pictures of a cell division, as shown in Figure 5. In A, the cell which is marked with an arrow first begins to round up step by step. Then a notch forms on both sides (B). These notches deepen, and in C two halves form. These then move in opposite directions as in D, leaving an elastic channel between them as in E. This tears suddenly and two new cells are formed (F).

An example of phagocytosis has been observed in the micro-film. In this case one cell actually eats up another cell. On the screen, this act of cannibalism appears as if the ingested cell melted into the substances of the one which takes it up. (Figure 6 A, B, C).

The micro-film has already proved an important aid in the study of normal cells. The study of the actions of bacteria and the influence of drugs as well as the study of diseased cells is still practically



SIX SEPARATE EXPOSURES CHOSEN FROM A LONG FILM, SHOWING ORDINARY CELL DIVISION OR MITOSIS

FIGURE 5: *Every one of the cells of every living thing comes into existence by the division of a preëxisting cell. That is, cells divide, forming new cells. Since this cell division applies to the germ cells as well as the body cells, life has really been a continuous stream from the beginning of evolution. The biological process which is summarized by these six pictures is described in the text. Shortly after these exposures were taken, an invading cell from above ate the new cell on the left*

an untouched field into which science hopes to delve.

The use of ultra-violet rays lying within a part of the spectrum of light which is invisible to the human eye but which nevertheless affect photographic emulsions, is another possibility. Thus we are able to see ultra-microscopic particles as, for example, the extremely minute spores of different bacteria to which the human eye is insensible.

The essential parts of the apparatus employed for making micro-films are: (see Figure 7), the optical bench with microscope and a source of light with its condensing system; the camera with drive and automatic timer or revolving shutter for the light; and the two motors, one of them with a reduction drive.

To make a micro-film the preparation to be used has first to be observed under the particular magnification at which it is to be filmed, in order to determine the number of pictures to be taken during a given time interval. The higher the magnification the quicker the apparent motion of the preparation. This is comparable to the observation of stars with a more or less powerful telescope, in relation to the motion of the earth—that is, the higher the magnification the faster they seem to move out of the field of view. The next step is to determine the amount of light necessary to illuminate the preparation sufficiently. This depends upon the magnification and also upon the number of exposures to be made during a given time interval. The more pictures per second or per minute, and the higher the magnification, the more light is necessary.

The living specimen is kept at the proper temperature by placing the microscope inside of a self-regulating incubator which is built around the microscope and arranged in such a way that the latter can be focused at will.

Predictions for Future Use

Too much light is injurious to the cultures, and in order to protect them there are two devices on the apparatus, namely, for low-frequency and a less powerful lamp (watt lamp), an automatic timer, which turns off the light while the film frame is changing in the camera; for high-frequency and the high-intensity arc lamp there is a revolving shutter which permits passage of the beam of light only for a short flash—just enough to give the film the right exposure.

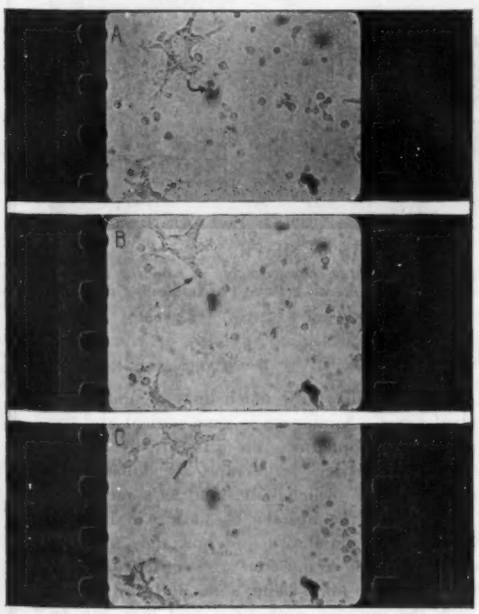
In order to observe the preparation under the microscope while the film is being taken, or to control the sharpness of the image, there is a special side piece attached to the microscope by means of a 45-degree transparent mirror, which takes off a fraction of the rays and projects them into an eyepiece.

In order to obtain a sharp picture there is another factor to overcome—vibration. Therefore, the motors and the camera with its drive are isolated from the optical part of the apparatus by means of three separate tables. It must be remembered that the slightest vibration of the specimen would be magnified through the microscope and would certainly spoil the picture. With this apparatus it is possible to make micro-films with any frequency between one picture every five minutes and twenty pictures per second.

To answer the requirements of the different speeds, which are different for every preparation and have to be determined as mentioned before, the camera is driven either by a motor with a worm drive attached or directly by another motor. For purposes of comparison it is mentioned that the normal speed used for the ordinary motion-picture projection is sixteen pictures per second.

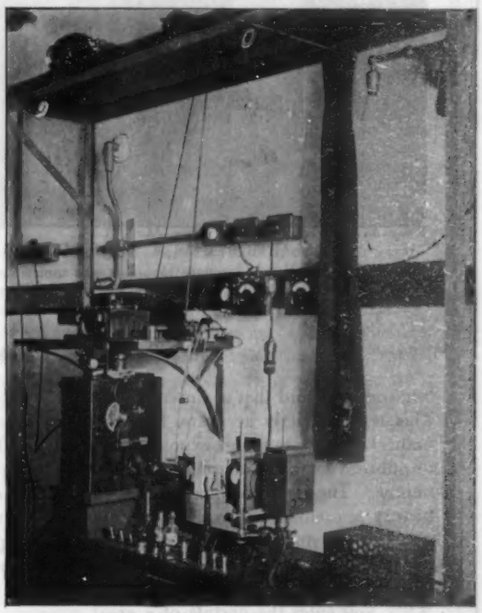
It has proved advantageous to see a micro-film over and over again, in order to study the details thoroughly. In micro-cinematography the right exposure will always be a new problem with every new preparation and a number of experiments has to precede the starting of work on making a new picture. Many things must be considered in order to give the film the proper amount of light: for example, the magnification, the number of pictures to be taken per minute or per second and the source of light, that is, whether watt lamps, pointo-lights or arc lamps or others are to be used.

The development of micro-cinematography is only in its beginning and many things remain to be done in the biological, medical and other scientific laboratories for studying and demonstrating the smallest (actions) motions of any kind of life. Some day there will exist a central library for the great number of scientific films so that they may be circulated among schools, universities, research laboratories, to help education and science.



CANNIBAL WHITE BLOOD-CORPUSCLES

FIGURE 6: *In* A *the phagocyte approaches its prey; in* B *it is being swallowed; in* C *it is inside*



THE MICRO-FILM APPARATUS

FIGURE 7: *This consists of a light source, a microscope, a camera, an automatic shutter and two motors*

SKILFUL REPAIR OF ART OBJECTS

Marbles, terra-cottas, vases and other art objects often arrive broken and are repaired by skilful artisans in the shops, under the curator's directions

GILDING THE FRAME OF AN OLD MASTER

Gilding is a beautiful art and a museum requires the best craftsmen to make the delicate repairs on old picture frames, mirrors and other gilded objects

Photographs courtesy of The Metropolitan Museum of Art

THE ARMORER IS A RARE MECHANIC

An actual armorer's shop where the tools are sometimes hundreds of years old. This shop is in the Hall of Armor

MENDING AND GETTING EXHIBITS IN SHAPE

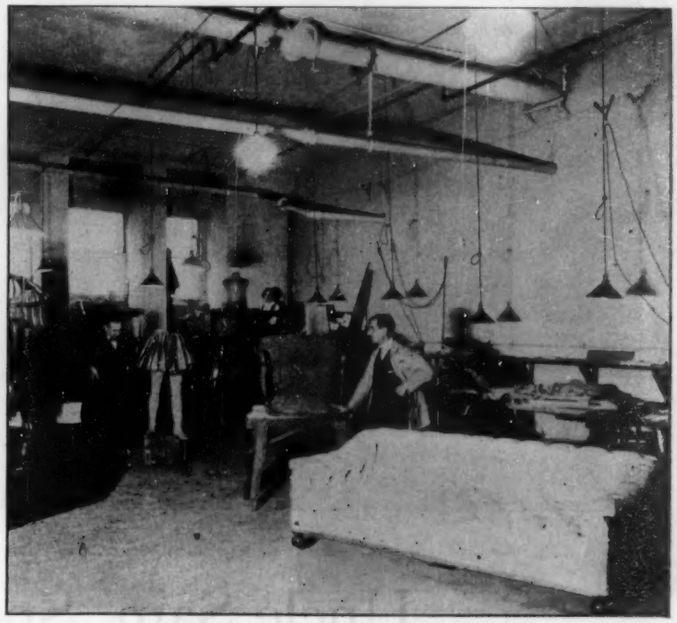
The exhibits are deftly repaired on immense stone tables in large shops, capable of handling work of any size and of any material. Stone bronze, iron or wood are all grist to this interesting shop

How a Great Museum Serves the Public

Someone has said that a museum is like an iceberg—only one-ninth visible. This is not strictly accurate, for as far as we can determine, our largest natural history museum exposes about 30 to 40 percent of its collections to public view. Art museums take care of objects which are in most cases unique. The immense quantities of specimens for study which the natural history museum has to have are not necessary here. Still, every art museum has to have ample storage space, shops for the repair of those pieces that have suffered in the fulness of time, and laboratories and photographic studios so that material for record and study can be secured. When you enter the portals of a great museum, you are at once impressed with the admirable grouping and classification of the objects shown, and the way they are displayed, but few realize how much thought and attention is given to every individual piece. A museum is very critical and the selection is made with extreme care. Sometimes, the gifts are by legacy, sometimes by actual purchase, and sometimes large sums are donated for securing some particular "museum piece" which will stand as a memorial for all time. A collector often makes the mistake of stating in his last will and testament, what exhibits must be shown and how they must be displayed. If the Board of Trustees of a museum are courageous, the bequest will usually be rejected. On the other hand, some collectors make their wills in cooperation with the museum authorities and they can be assured, while alive, of the integrity of their collections for all time. It

A PRINT SHOP PRODUCING BEAUTIFUL WORK

The printing plant at the Metropolitan Museum is a thing of beauty. Labels, invitations and other small pieces are produced perfectly by master printers



THE UPHOLSTERY SHOP IS ALWAYS BUSY

One of the vital departments in the Museum is the upholstery shop where expert men and women outfit mannequins or repair furniture and delicate fabrics

Photographs courtesy of The Metropolitan Museum of Art

TAKING THE SALT OUT OF ANTIQUE STONES

It is necessary for the stone specimens from Egypt to be soaked for months to remove the salt, which otherwise would disintegrate the sample

REPAIRING A BIG TAPESTRY BEFORE EXHIBITING

It sometimes takes many expert needle workers to repair a large tapestry. Such work is usually done all at once in an unoccupied gallery of the Museum

would be interesting to watch an object pass through the various steps of acceptance. Accessioning, registering, photographing, repairing if necessary, and the preparation of the label or painted sign which gives the public the information they are so desirous of obtaining, are the steps in brief. Through the courtesy of the officials of the Metropolitan Museum of Art, we are enabled to show some views of their shops and their printery where the labels and posters are prepared. We do not show the more utilitarian shops where cases are built, pictures glazed and the hundred and one wants of the Museum are supplied. Of course, this "nether world" of the Museum is not shown to the public, for the workers require quiet to carry on their unique trades. Several of the activities of the Museum are especially interesting to the average visitor. The collection of photographs of objects in the Museum numbers thousands. Practically everything except objects which have been deposited as a loan have been photographed and prints can often be secured in a number of different sizes. The reference library is much used, as is natural in an art Museum, and if there is any cut or text which is desired, a photostat can be made from the original book. Over eighty thousand photographs in the collection are thus made useful to students. Educational catalogs are also available. They help the visitor to understand the objects he is viewing and are valuable for subsequent research. Lectures, moving pictures and an immense collection of stereopticon slides are used both within the Museum and for general educational purposes. Concerts are given each winter which are attended by thousands, and those who desire to dine can do so and secure good places to hear the concert. These are a few of the facilities offered to the public. Those who live in New York or visit the city occasionally have a great treat constantly presented, for the Museum is open every day in the year. Sundays the Museum is open in the afternoon.

Bureau of Plant Industry, U. S. Department of Agriculture

CROP REFUSE IS NOW PRESERVED IN SILOS FOR WINTER FEED

Pea vines and corn husks, formerly waste products from canning plants, are now preserved as silage and extensively used for feeding purposes

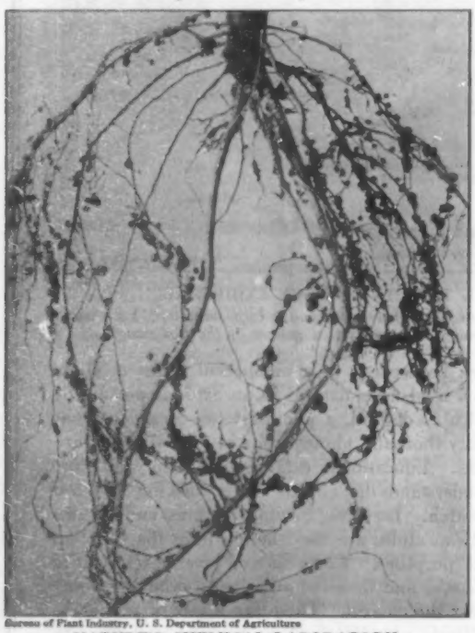
Uncle Sam, Spendthrift—VIII

Our Virgin Soils Were Formerly Rich in Plant Food. We Have Been Taking This Food Out and Putting Very Little Back, Thus Exhausting the Soil

By J. Bernard Walker

IN the course of this series on conservation, we have shown that, although nature lavishly enriched these United States with forests, game, coal, oil, et cetera, its people have been spending this wealth with such insane prodigality that, only by strict conservation, can we prevent its ultimate, and, in some cases, early extinction.

In the present chapter, we shall consider the soils of the United States—the greatest, and potentially, the richest natural wealth which we possess. How greatly the soil overtops every other source of revenue in the country is shown by the fact that the total value in 1925 of the farm crops and animals (both products of the soil) was 13,333,000,000 dollars, whereas the total combined value of the output of the two great industries which rank next to farming, namely, steel and motor vehicles, was 6,525,681,000 dollars, or less than half as great. In spite of the enormous growth of the industries of the country, the farm stands today as the backbone of our national structure.



Bureau of Plant Industry, U. S. Department of Agriculture

NATURE'S CHEMICAL LABORATORY

This shows soy-bean roots with nodules. Legumes obtain nitrogen from the air through these nodules. The poorer the soil is in nitrates, the greater will be the amount of nitrogen a legume will draw from the air

Soil a Vast Chemical Laboratory

The average individual is apt to think of soil as a mass of inert matter into which plant life thrusts its roots and from which it draws such nutriment as is necessary for its growth. But the soil is not inert. On the contrary, it is very much alive and may be likened to an active biological and chemical laboratory. In addition to the elements which are necessary for plant growth, there are many other substances which are constantly at work in the soils and tend to make the needed elements for plant life more or less soluble. Every fairly good soil, moreover, is filled with bacteria, molds, and minute animals forms. These also cause changes in the soil that are usually, although not always, beneficial to plant life. Certain of these bacteria are particularly useful in promoting the health and growth of the crops, and such bacteria are most effective where there is plenty of organic matter present and sufficient air and moisture. This organic matter may be supplied by stable manure or by plowing into the ground the stubble left after the crops have been cut, or by what are known as green manures.

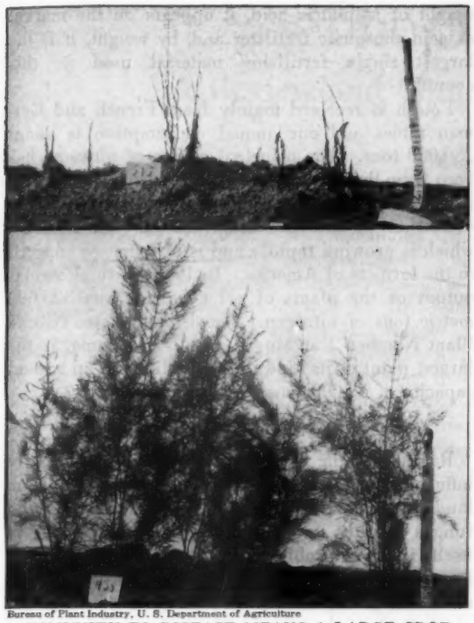
When the early settlers occupied the virgin lands of the United States, the soil—except in considerable areas of the so-called desert regions—was rich in such substances as are necessary to the production of corn, wheat, rye, grass and other crops which are needful for the life of man and beast. When the surface of these lands was broken by the plow and seeded, the earth gave forth with rich abundance. Crops of wheat of 50 or 60 bushels or more to the acre were frequent, and the pioneer farmer gave little thought, if any at all, to the question of fertilization. Why should he, with the earth giving such an abundant yield? And so, year after year and decade after decade, he planted and reaped, with little or no thought for the future, and certainly with no fear that a soil so fecund would ever fail to yield its rich harvests in due season.

Nevertheless, as the years passed by, the yield began steadily, if rather slowly, to decrease, until the time came when on certain of the once rich lands, the sons of the first comers found that, whereas their fathers had gathered in harvests that ran 60 bushels to the acre, they were able to raise

Photograph by A. G. Johnson

WHAT INFECTED SOIL WILL DO

Wheat grown in experimental plot on farm near Lincolnton, North Carolina. LEFT: *Fulcaster wheat from three running feet in uninfected spot.* RIGHT: *same variety of wheat from three running feet in infected area*



Bureau of Plant Industry, U. S. Department of Agriculture

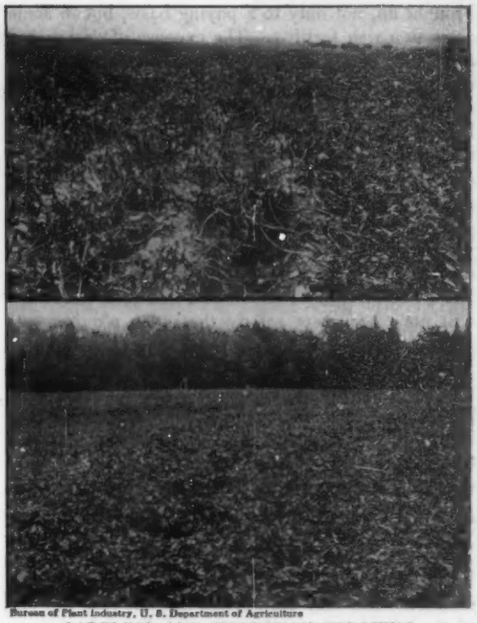
IMMUNITY TO DISEASE MEANS A LARGE CROP

The relative resistance of two varieties of asparagus to rust. The plants were grown in the same environment, but the Martha Washington variety, produced by crossing resistant plants, shows no injury from the disease

Bureau of Plant Industry, U. S. Department of Agriculture

OVERCOMING THE WART DISEASE

Typical hills of potatoes grown in soil heavily infested with the potato-wart disease. The hill at the left is of an immune variety, while the hill at the right is susceptible to the disease, and the tubers have been converted into the worthless warty growths shown in the photograph



Bureau of Plant Industry, U. S. Department of Agriculture

CARELESS AND THOROUGH SPRAYING

Disease control through spraying. The upper field was lightly sprayed. The field below was thoroughly sprayed and remains uninjured. Green leaves in abundance are necessary for the growth of the potato tubers

but 30 or 35 bushels to the acre. The process of decline went on until it reached a point where the farmer was able to garner from these once rich soils a harvest that ran only 10 to 15 bushels to the acre.

This decline was inevitable, since every crop that was reaped left the soil poorer by the amount of nutriment that had been taken out. All out-go and no income spelled, in crop raising as in any mill or factory, an ultimate goal of bankruptcy.

In what we have said above, we had in mind particularly some of the richer wheat fields of the west; but the process of exhaustion, through the continual raising of the same crop year after year, has been going on all over the United States. In certain districts there are to be found farms whose yield has fallen so low, that they have become unprofitable to work and have been abandoned. Such methods are the methods of the spendthrift, and the prodigality with which the people of the United States have swept away their forests and are now engaged in exhausting their supplies of fuel, and in destroying the game life of the sea, the land, and the sky, has resulted in the exhaustion of a considerable area of the once fertile lands of the United States.

Before giving further consideration to the impoverishment of the soil by the continual planting of the same crop, it should be stated that, although the loss of fertility from this cause is serious, it is not so grave a peril as that due to the continual washing away of the surface soil by erosion. Erosion, according to Hugh Hammond Bennett, of the United States Bureau of Soils, is, by far, the most serious agent of destruction. "Soil erosion," says he, "costs the farmers of the United States more than 200,000,000 dollars every year. Destruction and deterioration from this cause occur in every state of the Union, and in almost every county of every state."

The Government Stands Ready to Help

This, however, is another story, calling for separate treatment, and we shall present in our next issue a chapter by Mr. Bennett, which, with the aid of some highly dramatic photographs, will show the very serious nature of this unhindered washing away of the surface soil.

Although as regards plant life it may be urged on behalf of farmers of an earlier day that they knew nothing about the chemistry of the soil, and perhaps not much more about the value of rotation of crops, no such excuse can be offered today. The United States Department of Agriculture is one of the best organized and most efficient departments of our Government. In its employ is a large staff of experts, specially trained for their work, who have made a deep study, not only of agricultural conditions in the United States, but of those existing in all the countries of the world. Particularly is this true of the Bureau of Soils and Bureau of Plant Industry—the results of whose investigations are published from time to time in what are known as "farmers bulletins" and circulated throughout the country. Furthermore, these Bureaus have made it a point to extend every possible courtesy in the way of information and advice to those farmers who present to them their many problems.

The effect of this good work upon agriculture in the United States has been widespread, and where the advice and methods of the Bureau have been followed, the results, as the accompanying illustrations show, have been truly amazing. Farms, which under unintelligent farming had become so barren that it no longer paid to work them, have been

Bureau of Agricultural Economics, U. S. Department of Agriculture

EASY-GOING FARMING

Growth of corn on a Virginia field worn out by long cropping and washing, with resulting waste of nitrogen. Yield, 18 bushels per acre once in three years; weeds, two years in three. The run-down condition of this field shows what happens when the owner is too indolent to practice up-to-date farming. See next picture

Bureau of Agricultural Economics, U. S. Department of Agriculture

UP-TO-DATE FARMING

Corn on the same field after five years of seeding crimson clover in with the corn at last planting and turning it under the following spring. In this way there was no loss of time and corn was grown every year, for the crimson clover prevented waste and increased the nitrogen in the soil. Yields 50 bushels of corn every year

brought up, not only to a paying basis, but in some cases to a rich fertility. The expense of reclaiming a farm is not great—the largest investment being that of patience and perseverance. In fact, the science of agriculture and the means for the distribution of knowledge have reached a point at which it may be said that the principal agents in the deterioration and destruction of farms are the indolence and wilful ignorance of the owners.

In an earlier day it was considered that sufficient nutriment was given to the soil if the last season's manure was spread over its surface and plowed in, but it has come to be understood that mere manuring will not everywhere satisfy the many requirements of the soil, or serve to restore what was taken out of it by the previous crop. One of the most advantageous and now widely used methods is what is known as "green manuring." This consists in the sowing of certain leguminous crops, in rotation with the crops of corn, wheat, et cetera, and plowing the green crop into the soil. Crop rotation was practised by the Roman farmer 2,000 years ago.

Legumes for Nitrogen

Not only do the legumes supply the needed organic material when they are plowed into the soil, but one of the most important functions of these plants is to obtain nitrogen from the air for the enrichment of the soil. If you pull up one of the legumes, such as red clover or the soy bean, you will find upon its roots a large number of nodules—some quite small and others as large as a pigeon's egg. These nodules are caused by a certain kind of bacteria, and it is by these bacteria that the nitrogen of the air is absorbed, so that it can be used by the clover or other legumes. To determine the amount of nitrogen thus acquired by the soil, the Michigan Agricultural Experiment Station grew soy beans, inoculating with nodule-forming bacteria the soil on one field and leaving another uninoculated. Analysis showed that about two-thirds of the total nitrogen was taken from the soil and one-third from the air. Another experiment by the Illinois Agricultural Experiment Station, carried out with alfalfa, showed that on the inoculated plots of ground the alfalfa in the crops for the season contained nearly 160 pounds more nitrogen per acre than the crop from the uninoculated plots.

There are in the United States fourteen leguminous field crops that are more or less extensively grown, among which, in the order of importance, may be mentioned three varieties of red clover, and alfalfa, cowpeas, peanuts, soy beans and several others. Not in every case will it be more profitable to plow a green crop into the ground than to use it for forage. According to the Bureau of Plant Industry, where a forage crop can be grazed or advantageously fed and the manure returned to the land, this will be found most profitable. Where insufficient livestock is kept, or where the soil is poor and in need of organic matter, a green crop might often be worth more in the long run if turned under than if sold.

Bureau of Plant Industry, U. S. Department of Agriculture

WILT-RESISTANT WATERMELONS

Wilt-resistant watermelon planted in a badly infested field. The bare spots on either side were planted with commercial melons, which have been killed. The resistant melon, known as the Conqueror, was produced as the result of crossing. While it has not become commercially important, its production was of great significance, since it was one of the first instances in which the possibility of developing resistant plants through cross-breeding was demonstrated

Although Dr. F. E. Allison has stated that lack of nitrogen more than any other element is responsible for low crop yields in the United States, two other elements—phosphorus and potash—are also removed from the soil by crops and must be restored thereto. The phosphorus for fertilizer is obtained in the United States from the beds of phosphate rock in Florida, Tennessee and Idaho. Treated with its own weight of sulphuric acid, it appears on the market as acid-phosphate fertilizer and, by weight, it is the largest single fertilizing material used in this country.

Potash is received mainly from French and German mines and our annual consumption is about 250,000 tons. The principal source of nitrogen has been from the natural crude nitrate deposits of Chile. A comparatively recent development has been the extraction of nitrogen from the air—an industry which is growing rapidly and is of immense concern to the farmers of America. In 1918 the total annual output of the plants of all countries was 325,000 metric tons of nitrogen. The United States Nitrate Plant Number 2 at Muscle Shoals, Alabama, is the largest plant of its kind in the world, with an annual capacity of 40,000 tons of nitrogen.

Scientific Farming the Answer

Ranking of the first importance in the destructive influences that tend to reduce the yields of our farm lands is the damaging effect of harmful bacteria and fungus growths upon the growing crops. This, in itself, is a big problem into which we cannot enter here in detail. It must suffice to say that the Department of Agriculture has undertaken a great amount of research in determining the nature of these pests and the best way to combat them. Spraying, we are all familiar with, but the public is not so familiar with the brilliant results which have been achieved in producing, by cross breeding, varieties of plant life which are immune to harmful bacteria. How far this has been successful is shown in our remarkable comparative pictures of the results obtained with potatoes, watermelons and cabbages. Also, the Department has developed methods for disinfecting seed, so as to insure that bacteriological diseases will not develop in the growing crops.

It will be understood that what has been written above is but a sketchy survey of the problem of soil exhaustion and soil recovery. There are, of course, thousands of farmers in the United States who are, and for many years have been, familiar with scientific farming; who practice it today; and whose fields afford striking evidence of what fine results can be obtained by up-to-date farming. But there are also thousands of farmers whose lands, covered by scanty and ragged crops, proclaim to the world either that they are ignorant of the most elementary principles of scientific farming, or that they are so indolent that they are content to eke out a hand-to-mouth existence.

Bureau of Plant Industry, U. S. Department of Agriculture

COW-PEAS RESISTANT TO DISEASE

A field of cow-peas showing comparative resistance to two diseases, known as wilt and root-knot. The rows at the left are a variety selected for resistance to these diseases

Bureau of Plant Industry, U. S. Department of Agriculture

SELECTED CABBAGE GROWS AND THRIVES

Yellows-resistant cabbage which was planted on cabbage-sick soil is shown at the right of this picture; the strip at the left was planted with ordinary commercial stock

The Month in Medical Science

A Review and Commentary on Progress in the Medical and Surgical Field

By Morris Fishbein, M.D.

Editor of the *Journal of the American Medical Association* and of *Hygeia*

Goat Serum for Measles

A GOAT which has been inoculated with bacterial organisms associated with measles produces in its blood a serum which has been found, by Dr. Ruth Tunnicliff and Dr. A. L. Hoyne of Chicago, to protect rabbits against inoculation with the same germs. It has been known for some time that human beings injected with the blood of persons convalescing from measles are protected against infection with the disease, and the same investigators found that persons inoculated with the serum obtained from goats injected as has been mentioned are also protected against the disease. A number of experiments have been made to prove this fact.

Goat serum prevented measles in 45 percent of the persons who received it on the fourth day after contact with measles patients, and in 97 percent of those who received it within the first three days after exposure. Ninety-eight percent of infants under one year of age, given the serum within the first four days after exposure to measles, failed to develop any signs of the disease, whereas all of the infants under one year of age who received the serum after the fourth day after exposure developed measles.

The immunity that is produced in this way does not last long, probably only a few weeks, but it is obvious that such a serum must be useful in preventing measles in very young and in weak children, and in stopping epidemics in institutions, such as orphan asylums, where the inconvenience of an epidemic is great and where the mortality may be very high.

Fat Cure Fakery

IN these times when women are sacrificing life and health, if not comfort, to adapt themselves to the craze for slenderness, the nostrum makers are using feminine pride for their own financial prosperity. Not long ago the United States Government issued a fraud order against the firm that put out "Silph" reducing gum, a chewing gum which was found to contain thyroid extract, pepsin and pancreatin, in addition to extracts of some herbs that could not possibly have any effect in the reduction of weight, but which are held by superstition to be valuable for the purpose. One of these, it appears, constitutes the major portion of the diet of Irish hogs which are notoriously slender, the slenderness being due to a lack of nutrition rather than to any particular virtue in the bladderwrack concerned.

The American Medical Association has recently completed an analysis of two other fat-reducing preparations, one of them known as "Slends Fat-Reducing Chewing Gum" and the other as "Elfin Fat-Reducing Gum Drops." The first preparation contains phenolphthalein, which is a cathartic drug, and also phytolacca, the extract of pokeroot which has been credited by quacks with certain virtues as an antifat remedy. Actually the effects of "Slends" are achieved by the large dose of the laxative that it contains and by the directions which accompany the package, urging the purchaser to walk vigorously five miles in the open air, to carry out certain exercises and to avoid the liberal use of potatoes.

The fat-reducing gum drops are also accompanied by instructions to use only orange juice as a beverage and to eat one-half the amount of food ordinarily taken. Bread is also to be avoided. These gum drops were found to contain phenolphthalein in a one-third larger dose than was found in the chewing gum. One of the added dangers is the fact that some persons are unusually sensitive to phenolphthalein and break out with severe eruptions when they take it.

Plasmochin, New Malaria Remedy

OF all of the diseases affecting mankind, malaria seems to have been of the most importance in relation to the history of the world. It has been said that the famous civilizations of Greece and Rome fell because of the onslaughts of this disease. The battle against malaria has been unending, particularly in tropical countries. The disease has been largely eliminated in the United States by the control of mosquito-breeding swamps. It was found definitely by Ronald Ross that malaria is transmitted by the bite of a mosquito which has previously fed on the blood of a person infected with the disease.

Since the time of the famous Countess of Chinchon, the bark of the cinchona tree has been known to civilization as a specific remedy for the disease. Quinin is the active principle of the cinchona bark. There are, however, many persons who are "quinin fast" and who apparently cannot be cured with quinin, even when the drug is given by injections into a vein.

Germany, with its numerous colonies, has constantly urged its pharmacologists to investigations for the control of tropical disorders. A few years ago it was announced that Bayer "205" had been discovered in German laboratories to be specific against African sleeping sickness, and that Germany would keep the secret of its composition but would sell it to the allies only for the return of the colonies.

Now German chemists announce the preparation of quinin in a new form to which they have given the name "plasmochin." It is claimed that this drug is far more potent than any form of quinin now known and that it attacks the parasites of malaria and checks their development so that they may be killed by the defensive forces found in the human body.

It was announced a few years ago that the disease general paresis, heretofore incurable, could be checked by infection of the patient with malaria. Apparently the organisms responsible for general paresis could not live in a body subject to the malarial disease. Persons thus artificially infected with malaria have now been treated with the plasmochin remedy, and it is said that they have been completely cured in a brief period.

In view of the fact that the nature of the remedy is secret and that all of the reports thus far available emanate from Germany, scientific opinion is being reserved as to the exact value of the new discovery.

Calcium in the Diet

AMONG the inorganic substances in the human body, including such materials as iron, phosphorus, iodine and other elements, calcium is as important as any. In a grown man, it furnishes 2 percent of his total weight. Practically all of this is found in the bones and in the teeth. Calcium is present, however, also in the blood and in practically all of the parts of the body.

It is therefore important that every person take a certain amount of calcium into the body regularly in order to sustain the calcium level. Dr. Donald Macomber of Boston points out that there are three periods in life when calcium is especially demanded: (1) During the period of growth when bulk is being added rapidly to all of the tissues; (2) During pregnancy when the mother must supply calcium for the bones of the developing infant; (3) During the nursing period when the milk from the mother must act as a source of calcium for the growing child.

Recent discoveries indicate that calcium, phosphorus and the antirachitic vitamin, or vitamin D, are necessary for the proper use of these salts in the body. It is possible also that various glands are involved in the control of the use of calcium, since parathyrin, the active principle of the parathyroid glands, acts definitely to control the amount of calcium in the blood.

In a number of experiments undertaken by Dr. Macomber in the Research Laboratories of Harvard University, it was found that a low amount of calcium affected the fertility of rats by increasing the number of deaths during the growth of the young within the mother's body. When the mother rat nursed her young she lost calcium from her body rapidly to supply its needs. If she was not supplied with additional calcium, the young soon showed signs of the lack of this substance by stunting, weakness, and often by death.

These facts obviously are a lesson in the dietetic management of pregnancy and the nursing periods in women. "There must be an adequate source of calcium in the diet of the pregnant woman," said Dr. Macomber, "if these functions are to be carried out normally and with a minimum of such disturbances as caries of the teeth, still-birth and failure of proper development of the infant."

The diet for the pregnant woman must contain an adequate amount of calcium. This is best obtained from milk, or milk products. The cow gets calcium from green grass or green vegetables, which may be an added source of calcium for the human being, although it will be hard for a human being to obtain sufficient calcium from green vegetables alone. Phosphorus is supplied from milk and from vegetables, and vitamin D, or the antirachitic vitamin which is essential for the proper use of calcium, is found in leafy vegetables, green vegetables, in the germ of grains, and above all in cod-liver oil.

Man Versus Woman

THE fact that several women were successful in swimming the English Channel caused one recent woman swimmer to remark that women are equal to men in athletics. A British physician who has given special consideration to the subject characterizes this remark as simple nonsense. The greater height of men and the type of their muscularity makes them superior in most athletic endeavors. Furthermore, women have smaller lungs and weaker blood cells than men in the proportion of four to five, and therefore a lessened physical capacity because of the possibility of rapidity of oxygen usage.

There have been numerous debates as to the mental capabilities of men and women, but thus far without any positive conclusions. "While genius is more common in the male sex," said Dr. Harry Campbell, "so is idiocy."

Marconi Strides Onward

Beam Transmitters Pronounced a Big Success and a Milestone in the Progress of Radio

By Orrin E. Dunlap, Jr.

Photographs by Underwood & Underwood and Kadel & Herbert

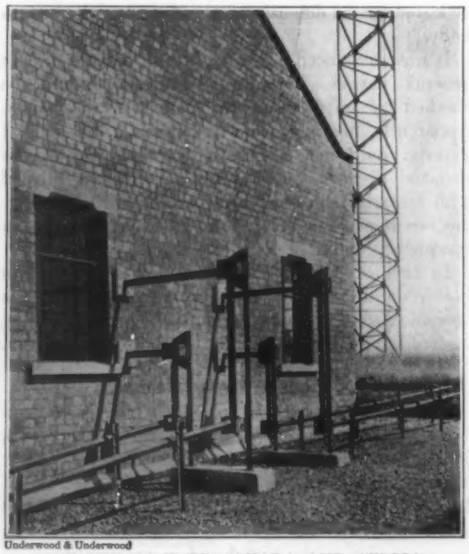
A QUARTER of a century has passed since Guglielmo Marconi, on December 12, 1901, picked up the first transatlantic signal, the letter "S," radiated from the aerial of the big spark station at Poldhu, Cornwall, on the southwest tip of England. Not content with this triumph, which won him international fame, Senatore Marconi has made good use of his time for the past 25 years by conducting exhaustive experiments in an effort to make radio more efficient and economical, thus enabling the ether to be a medium of public service on a world-wide scale.

In 1922 Marconi came to the United States and demonstrated before the Institute of Radio Engineers a "baby wireless set," which flashed a shaft of electric energy across the stage of an auditorium in New York in any desired direction. To the audience, he seemed like a magician as he waved an electric wand which released a beam of invisible energy in a definite direction, causing a bell to ring as proof that the system was in operation.

The American engineers present at the meeting included the most prominent radio and electrical experts on this side of the Atlantic. They watched the wizard of wireless with amazement as he used the midget installation to show them that he had many "tricks up his sleeve" regarding short wavelengths.

On one end of the stage, the master of wireless placed a reflector apparatus, and, on the other side of the platform, a horizontal metal standard. When the semi-circular reflector, a skeleton frame covered with wire, and resembling a dish cut in half, was turned with its open side toward the receiving station, the signals were loud and clear. When the open part of the apparatus was turned away, the signals disappeared. Marconi explained that this demonstration merely showed that the short-wave field was capable of high development and usefulness. Those close to the inventor knew that this equipment was the "baby" of a new system of long-distance transmission.

Then, on July 10, 1924, while lecturing before Rome's intellectual world in the Hall of Horatii and Curiatii in the Capitoline Building, Marconi said that the development of radio had been following a blind alley by the constant use of long waves, some of which were ten miles in length. He prophesied that soon nothing but stations of very small power outputs would be in use, due to the application of discoveries on short wavelengths. He revealed that he and his engineer, C. S. Franklin, had patented a system, which projected the Hertzian waves in a definite direction, just as beams of light are shot out by a searchlight. He said that he had applied to radio waves the principle that man applied to light beams when he first placed a reflector in lamps and lanterns to prevent the rays spreading in all directions and to concentrate them in the line desired. Thus, if London was sending to New York, receivers in Connecticut would probably be able to eavesdrop, but, in the words of Marconi, "Spain could not hear, nor could Sweden."



Underwood & Underwood

ON THE WAY TO CANADA AND AFRICA

The feeder system at Bridgewater. The tubes at left carry Canadian messages and those at right, African traffic

Marconi's first experiments with the directional system demonstrated that reflectors composed of a small number of wires placed parallel to the antenna and spaced around it on a parabolic curve of which the transmitting, or receiving antenna, constitutes the focal line, was a much more practical arrangement than the sheets of solid metal employed as reflectors in earlier tests.

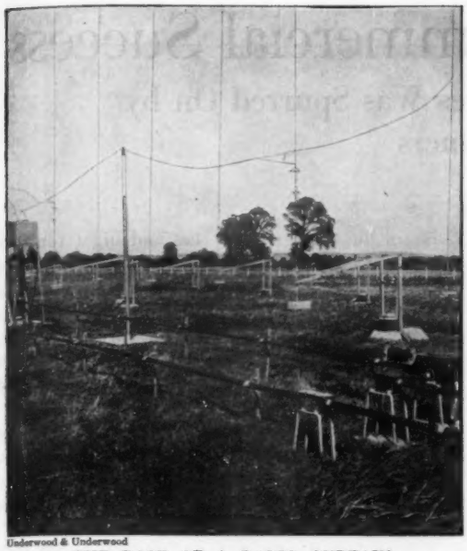
In 1917 Marconi moved his laboratory from Italy to England and there he developed the beam system in tests made between a transmitter at Poldhu and his yacht *Elettra*, sailing in the vicinity of Cape Verde Islands.

It was in 1923 that the British Government decided to proceed with the erection of wireless stations to communicate with the Dominions. While negotiations were proceeding with the Marconi Wireless Telegraph Company for the erection of high-power, long-wave installations, Senatore Marconi became convinced, as the result of his experiments, that a new system of wireless telegraphy could be developed that would enable the plan to be carried out much more efficiently and at a much lower cost than was contemplated.

His plan was to use short waves, below 100 meters in length, concentrated into a narrow beam by reflectors. So convincing were his arguments in favor of the new system that the entire technical policy of Imperial wireless communication was revised and the Government entered into a contract with the Marconi Company to build short-wave beam stations in England for communication with Canada, Australia, South Africa and India. The Dominions were equally impressed with the value of the beams and they too contracted to build corresponding stations to communicate with those erected in England.

Construction of the stations began in April, 1925, and on October 7, 1926, tests were begun between England and Canada, with the result that all guarantees, which were regarded by engineers as extremely stringent, were fulfilled.

The transatlantic beam now in commercial service provides the fastest wireless service in the world by sending and receiving 1,250 letters a minute in each direction, equivalent to 2,500 letters a minute over



Underwood & Underwood

THE BASE OF A RADIO CURTAIN

The aerial-coupling box of the Bridgewater station is on the left. In the background is the balance-weight system that equalizes strains on the wires

the complete circuit. On the basis of every hour of a seven-day test, however, the speed averaged 600 letters a minute in each direction, or 1,200 letters a minute for the complete circuit. Long-wave commercial wireless seldom, if ever, achieves a speed of transmission even half as great as this. In the new system the maximum rate of transmission is not fixed, but is highly elastic; the speed of sending messages is limited only by the mechanical capacity of the transmitting and receiving instruments. This means that the present equipment will be capable of handling all the traffic between Canada and Great Britain for many years to come.

Another highly significant feature of the system is the extraordinary clarity obtained, the signal strength having been pronounced 100 times that obtainable with non-directional transmitting and receiving antennas using the same power and the same wavelength.

The engineers of the Marconi Company call attention to the fact that, in the beam system, the radiated energy is concentrated in one direction, instead of being broadcast to all points of the compass, as in ordinary radio. And aside from requiring much less power over a given distance there is comparative freedom from interference. Whether this method insures secrecy is still a question. It is contended that interception of messages within 150 miles of the beam's path is possible. Auditors in New York have no difficulty in hearing the beam operating between Montreal and London.

In each Dominion there will be two beam stations, one a transmitter and the other a receiver. In Canada the receiver is located at Yamachiche and the sending station at Drummondville, 30 miles east of Montreal. Yamachiche is 25 miles north of Drummondville. Both stations are linked up by land wire with the main office of the Marconi Company in Montreal.

There are two aerial systems at each of the Canadian stations, one having five masts 300 feet high, and the other, three masts 250 feet high. Each mast system supports a curtain of aerial wires and a deflector curtain, and while one curtain directs the electrical impulses toward England, the other projects it toward Australia.

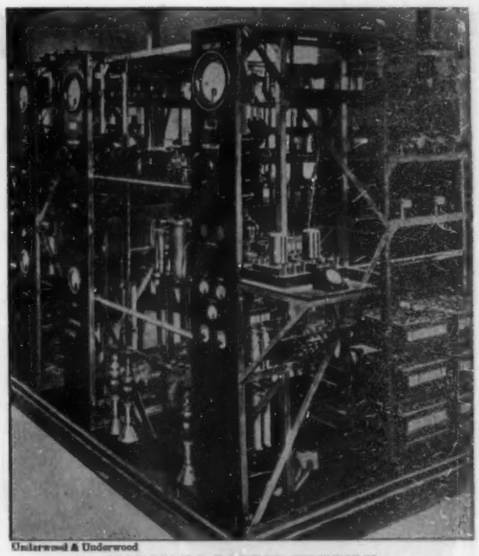
Each transmitter will require 50 kilowatts for operation. At Drummondville 48,000 volts supplied by the Southern Canadian Power Company is stepped down through a sub-station on the site to 550 volts, which is used to drive the generative sets to provide power for the 10,000-volt direct-current rectifiers and other auxiliary plants employed in connection with the beam.

Reputations Staked on Beam Radio

The transmitting stations in England are located on Bodmin Moor in Cornwall for communication with Canada and Cape Town, South Africa, and at Tetney, near Grimsby, for communication with Poona, India and Melbourne, Australia. The receivers are located at Bridgewater, in Somerset and at Winthorpe, near Skegness.

The Bodmin station, which is built upon a strip of land bordering the main Bodmin-Truro road, four and one-half miles southwest of the Cornish county town, consists of two transmitting systems, one projecting a beam to South Africa and the other to Canada.

The masts and aerial system, the design of which is peculiar to the short-wave beam system, is entirely different from the design previously used in commercial wireless stations. The five lattice steel towers are erected in a straight line and aligned so that the great circle bearing on the distant station is at right angles to the line of the towers. The beam is therefore projected accurately in the direction of the receiver with which communication is being maintained. Cross arms at the top of the masts measure 90 feet across and from them drops the wire curtain suspended from steel cables attached to the cross arms. The aerial is on one side of the masts, facing the receiver, and the reflector is on the opposite side.



Underwood & Underwood

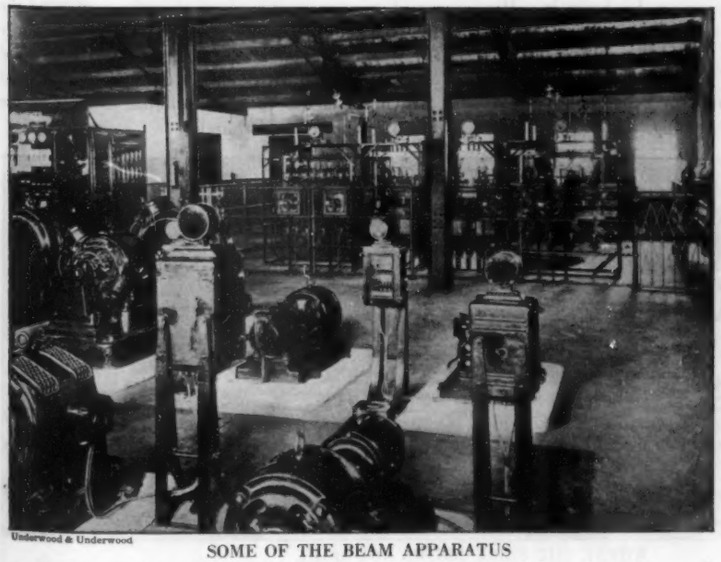
MARCONI'S LATEST TRIUMPH

The compact, short-wave beam transmitter. The meters are mounted on ebonite panels. On the shelf in the foreground are the signaling relays

The transmitter is of entirely new design throughout and is extremely compact. Exceptional care is taken to maintain stability of wavelength which is of the greatest importance, especially in short-wave work.

Portugal also has several beam stations under construction for linking up its colonies through a concession obtained by the Marconi Company. These stations are being built at Lisbon, and in Africa at Loanda and Mozambique.

When the Marconi Company undertook the beam project, it was considered to have staked its reputation and also that of Senatore Marconi, so great were the apprehensions over the success of beam wireless. Today it is apparent that beam wireless marks the dawn of a new era in communication, with far-reaching effects not only for the British Empire but the world at large.



Underwood & Underwood

SOME OF THE BEAM APPARATUS

In the foreground are the generators and meter boxes of the Bodmin station. The panels with the controls for the rectifiers are also shown

Underwood & Underwood

INSIDE THE BODMIN STATION

The beam transmitters for Canada and Africa are on the right and left, respectively. The control apparatus is located on the center table

Inventors Who Have Achieved Commercial Success

The Man Interviewed for the Third Article of This Series Was Spurred On by Inability to Sell Poor Shipping Containers

By Milton Wright

HERBERT L. CARPENTER

The inventor of a fibre container for shipping purposes that has become a leader in its own field

"NECESSITY is the mother of invention." We have been hearing that phrase for as long as we can remember; it has become one of those aphorisms we accept without question. But is it really true in every case?

As a case in point, consider the fibre container for chemicals and food products invented by Herbert L. Carpenter. From nothing but an idea, a million-dollar corporation has grown, its product used by some of the biggest manufacturing companies.

Let Mr. Carpenter himself tell how he got started:

"I turned inventor because I was unable to sell something that just was not salable. There was a concern manufacturing a fibre pail for candies, in which I was an investor, and the company was losing money. Clearly, there was something wrong, so I went on the road as a salesman to find out just what it was. For sixty days I tried to sell those pails. At the end of that time I knew they could not be sold at a price that would return a profit.

"That sounded like bad news. In reality it was good news; it meant there was a far wider opportunity. Leading chemical and coffee men upon whom I called told me they were looking for a container that would have two qualities: it must be perfectly tight and it must be easy to handle. There was no such container in existence.

"I looked over the field. There were the standard wooden barrel and the steel drum. The barrel was not leak proof. Fill it with cocoa, hammer on the head, then throw it about, as it would be bound to be thrown in transit, and see how the cocoa would sift through. The steel drum had been developed probably as highly as modern science would permit, but it could not be used universally.

"To meet the demand I built twenty different kinds of drums; all of them were impractical. Finally I succeeded in perfecting a fibre drum, with an expanding steel rim, a triple seal and a unit closure. It was simplicity itself, and yet so novel I secured a patent embodying a large number of the broadest kind of claims."

The drum is a fibre shell made in layers. The head is a round disk of wood of special design. The rim is a steel hoop with a flange bent inwardly and cut in two sections, the intersections overlapping and one of them being hinged with a rivet. The seal is a circular sheet of flexible fibre.

When a drum is filled with baking powder, lard, condensed milk or what not, the fibre disk is laid over the top, the seal is wedged tightly into place by fitting in the wooden head, the seal is turned down around the edge, the edge is covered quickly with the steel rim and the latter is nailed securely into place.

But why is that simple affair so fraught with potential profits, you ask. The following statement made by *Barrel and Box* gives the answer:

"One of the inherent powers of a container often overlooked is its ability either to build or destroy business. If the container is designed correctly, built correctly, and fulfills its functions as a carrier it is a business builder in that it delivers its contents intact and safely. If, on the other hand, containers fail and cause damage to merchandise, resulting in loss and complaint to shipper and consignee, they are the direct cause of ill will and lost trade."

It is one thing, however, to produce a container that will answer the purpose, but quite another to produce it in quantities by methods that will make its manufacture and sale profitable. After Carpenter had made the drum he believed ideal, one problem was to invent automatic machinery that would turn them out.

Wood fibre comes in long sheets. The job was to roll this into drums without waste or lost motion. The fibre will vary, one edge being now thicker and now thinner than the other; it is bound to roll crooked. The first few made were rolled by hand. When they were sold, however, repeat orders began coming in and the need for machinery became pressing.

Box manufacturers declared that the manufacture of a perfect shell from commercial fibre without trimming was an impossibility. Nevertheless, Carpenter felt it to be necessary to the complete success of his enterprise, so he set about solving the problem, designing his machinery as he built it. His first expensive machine was built with microscopic accuracy and he had the greatest confidence in it. When completed, however, it was found to be utterly useless. It was built on the wrong principle; microscopic accuracy was not the thing.

Again he set to work. Day and night for four months he labored to find how to control that sheet of fibre as it passed around the roller. Finally he worked out a system of controls, automatic starter and lifts. A man stood beside the revolving roller, saw the sheet of fibre was beginning to work off to one side, turned a little screw and the sheet fed straight and true.

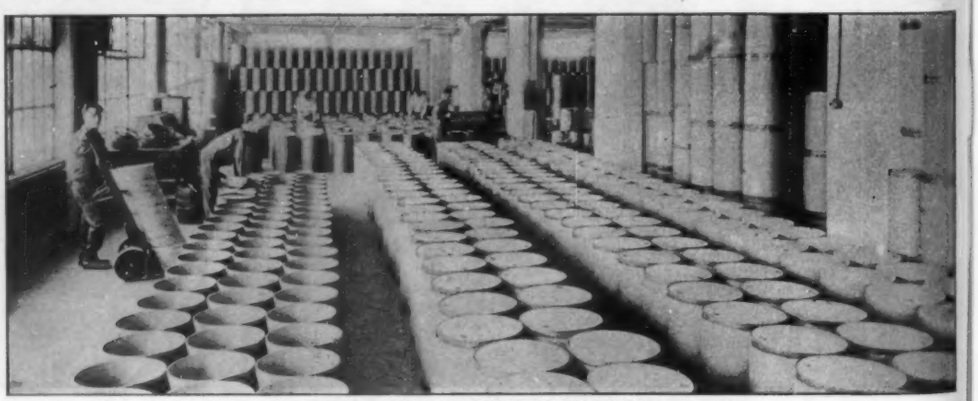
Here was one machine that could make any size container from three gallons up to forty-one gallons. With a single operator it could turn out 500 of the largest size in a day—more of the smaller sizes. It could do the work of 25 to 50 men.

When repeat orders came in they were larger than the original orders; firms who bought a hundred as an experiment later bought ten thousand at a time. Other manufacturers wanted them.

It was evident that business on a big scale was imminent. A group of financiers, their fingers on the pulse of business, approached the inventor and offered to help him finance a corporation that could handle the situation adequately. It was not to be a stock selling proposition with the money being made from investors, but a manufacturing and selling organization with the profits being made from users. A corporation with 1,000,000 dollars in preferred stock and 40,000 shares of no-par-value common stock was formed, with the inventor occupying the unique position of being president and chairman of the board of directors and retaining control.

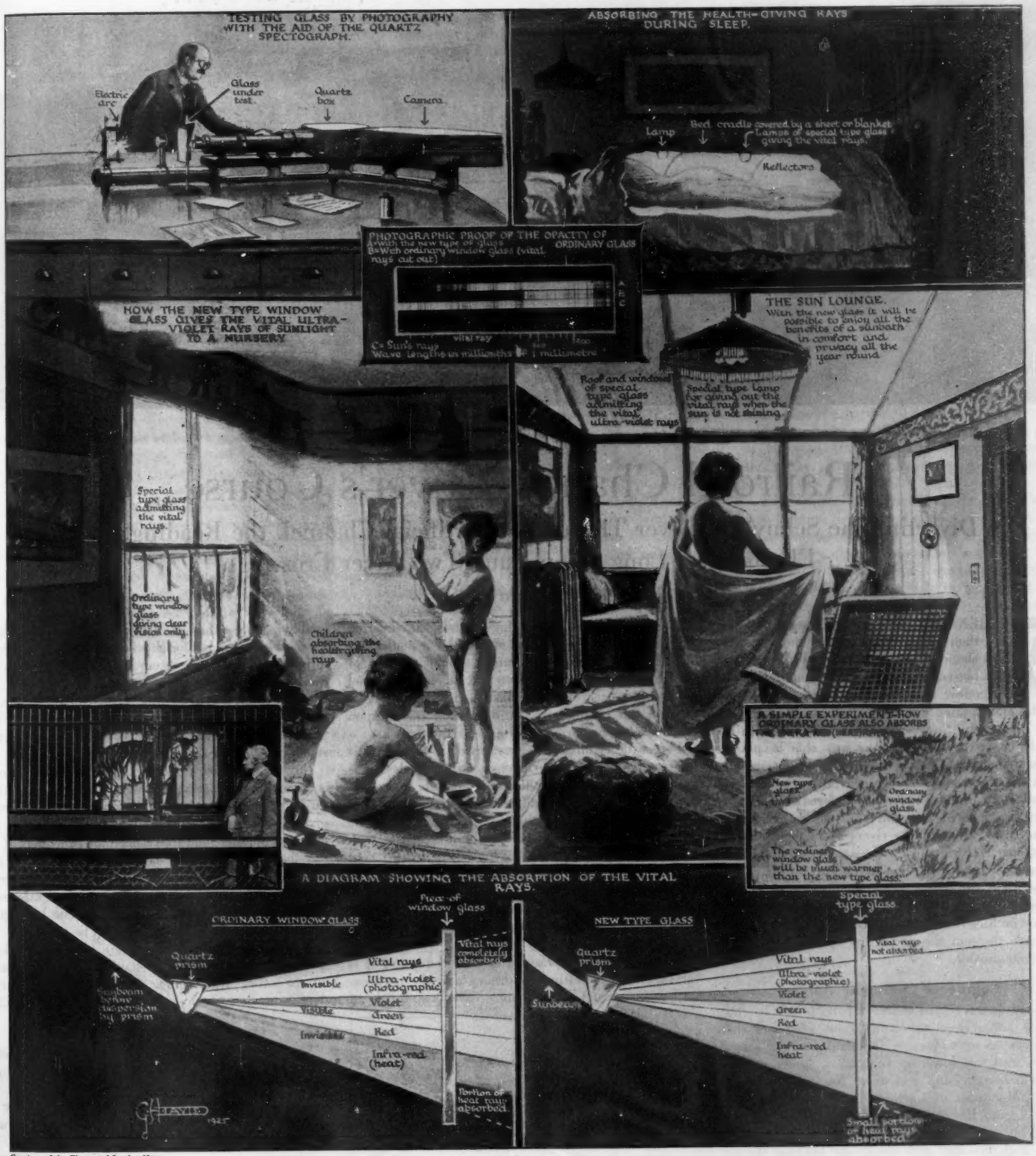
Soon nationally known houses began to use the drums; the first coffee shipped on the *Leviathan* went in the new containers; a packer has already shipped 4,000,000 pounds of fresh meats and lard in the novel drums; a drug manufacturer found them ideal for medical powders.

Leases were given to users and factories were erected for the manufacture of the containers, each of them paying royalties to the inventor's company. The inventor, following out the logical development of his idea, found himself obliged to bend his energies in still new directions. He made analytical studies of the manufacture of fibre and of the treatment of lumber, and back of this the getting of the lumber itself in the great North Woods. The supply of raw material, the machinery and the finished product, in a field in which the demand is great and in which he is the pioneer and the holder of the patent rights, are in his hands.



WHERE THE FIBRE DRUMS ARE MADE

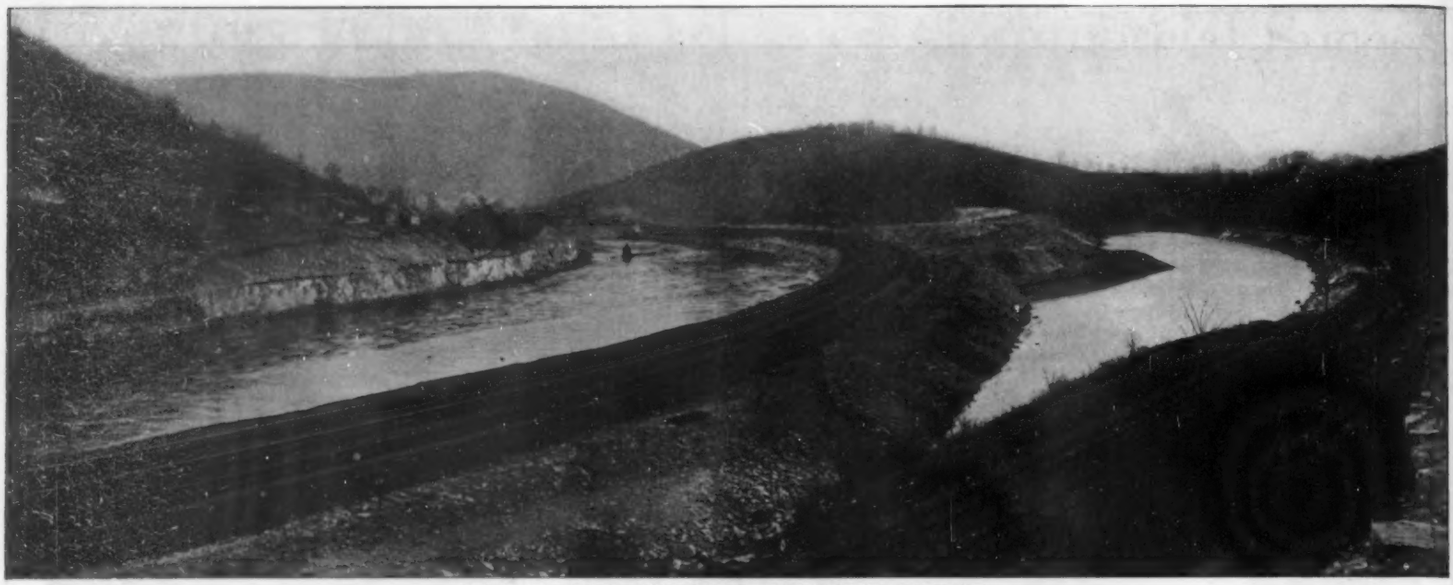
This shows the finishing room of one of several plants, each with a capacity of 25,000 containers a month. On the right are finished drums. On the truck at the left is a pile of covers


TESTING GLASS BY PHOTOGRAPHY WITH THE AID OF THE QUARTZ SPECTOGRAPH.
Electric arc
Glass under test
Quartz box
Camera
ABSORBING THE HEALTH-GIVING RAYS DURING SLEEP.
Lamp
Bed cradle covered by a sheet or blanket
Lamps of special type glass giving the vital rays
Reflectors
PHOTOGRAPHIC PROOF OF THE OPACITY OF ORDINARY GLASS
A-With the new type of glass
B-With ordinary window glass (vital rays cut out)
A
B
C
vital ray
C= Suns rays
Wave lengths in millionths of 1 millimetre
HOW THE NEW TYPE WINDOW GLASS GIVES THE VITAL ULTRA-VIOLET RAYS OF SUNLIGHT TO A NURSERY
Special type glass admitting the vital rays.
Ordinary type window glass giving clear vision only.
Children absorbing the health-giving rays
THE SUN LOUNGE.
With the new glass it will be possible to enjoy all the benefits of a sunbath in comfort and privacy all the year round
Roof and windows of special type glass admitting the vital ultra-violet rays
Special type lamp for giving out the vital rays when the sun is not shining
A SIMPLE EXPERIMENT-HOW ORDINARY GLASS ALSO ABSORBS
New type glass
Ordinary window glass
The ordinary window glass will be much warmer than the new type glass
A DIAGRAM SHOWING THE ABSORPTION OF THE VITAL RAYS.
ORDINARY WINDOW GLASS
Face of window glass
Quartz prism
Sunbeam before dispersion by prism
Vital rays
Invisible
Ultra-violet (photographic)
Violet
Visible
Green
Invisible
Red
Infra-red (heat)
Vital rays completely absorbed
Portion of heat rays absorbed
NEW TYPE GLASS
Special type glass
Quartz prism
Sunbeam
Vital rays
Ultra-violet (photographic)
Violet
Green
Red
Infra-red heat
Vital rays not absorbed
Small portion of heat rays absorbed

Courtesy of the *Illustrated London News*

New Glass Allows Ultra-violet Rays to Enter the Home

"Vitaglass" is the name of a new kind of glass which permits a true health-giving sun bath in the home. Ordinary window glass, no matter how clear, cuts off the invisible but strongly vital ultra-violet portion of the solar spectrum almost as effectively as a brick wall. Therefore the value of a sun bath in the most brilliant conservatory is virtually an illusion—the effect is largely mental. Special lamps giving ultra-violet light may now be had, but without the guidance of a physician they are a positive danger—one can get a more serious sunburn under them than in tropical sunshine. Recently several kinds of glass substitutes have been produced which do not filter out much of the ultra-violet light, and some of these are so inexpensive that an ordinary window may be had for a few dollars. It is only comparatively recently that man shut himself off from ultra-violet light: before the use of ordinary window glass began he obtained sufficient of it in the most natural way—from the sun. A large proportion of the malformed bones and bent legs of our generation may be charged to lack of ultra-violet light—a fact science has only recently understood.



TAKING A SHARP BEND OUT OF THE SCHUYLKILL RIVER

AT RIGHT: *the old channel.* AT LEFT: *the new artificial channel with the river flowing through.* IN CENTER: *the new double-track line, on bank formed by material from new channel*

Railroad Changes River's Course

By Diverting the Schuylkill River Through an Artificial Channel, the Reading Railroad Eliminates a Long Tunnel and Two River Crossings

By J. Bernard Walker

WHEN the pioneer railroads began to build their lines throughout the country, Dame Nature dictated how they should twist and turn and rise and fall in the effort to get where they wanted to go. On the open plains and broad valleys, the engineer who located the lines was confronted with a fairly simple task. In the main, he was able to plan a railroad that was fairly straight and approximately level. But when he came to the hilly country and the mountain ranges, the problem bristled with difficulties. As a rule, the only way he could advance was to follow the winding rivers up to their sources, and then either zig-zag up the steeper slopes of the mountainside, or face the heavy cost of driving a tunnel right through. These conditions, of course, necessitated the use of sharp curves and steep grades, to say nothing of expensive cuttings which had to be made through the projecting spurs or bluffs of the mountainside.

Engineers Overcome Nature

Today, however, the engineer is no longer so completely subservient to Nature, and now and then instances occur where, in the straightening out of curves and the lowering of grades, he is able to assert his mastership and make Nature do his bidding. Hundreds of millions of dollars have been spent during the past two or three decades in thus rectifying the location of pioneer roads which were built both crooked and steep, not because the engineer wished them to be so, but because capital was scarce and often impossible to find for better but much more costly work.

A notable instance of such revision, in which man has made Nature do his bidding, is to be found on the main line of the Reading Railroad where it runs through the beautiful, scenic foothills of the Blue Ridge Mountains. Here the line follows the windings of the Schuylkill River on its way to the coal fields of Pennsylvania. At a distance of about half a mile below Port Clinton, the river makes a very sharp bend to the left in the shape of an inverted "U," forming in the interior of the "U" a peninsular of characteristic low-lying land. In the revision of the line, the engineers have cut a wide channel through the neck of the peninsula, diverted the river through this channel, and laid the new tracks upon an embankment formed by the excavated rock.

Before describing this great work in detail, it is interesting to note that, in engineering circles, it is a well-known fact that the grades on the main line of the Reading Railroad, running from the coal fields to tidewater, are the best balanced set in the country. The line falls very gently down grade, with the result that coal trains of over 100 loaded coal cars weighing at times over 10,000 tons, are hauled by a single engine from the mines to tidewater; and so easy are the grades that the same trains are hauled back empty, by a single engine, on the return or upgrade journey.

The Reading is essentially a coal road, and it is the favorable operating conditions and the immense traffic of over 64 million tons—over two-thirds of which is coal—that enables this road to maintain its road-bed and rolling stock in such splendid condition, and gives the system its high position in the financial world. Only a road-bed and track of the very finest type could support such heavy traffic. It is laid throughout with steel rails weighing 130 pounds to the yard, upon steel tie-plates and creosoted ties carried on deep, stone ballast.

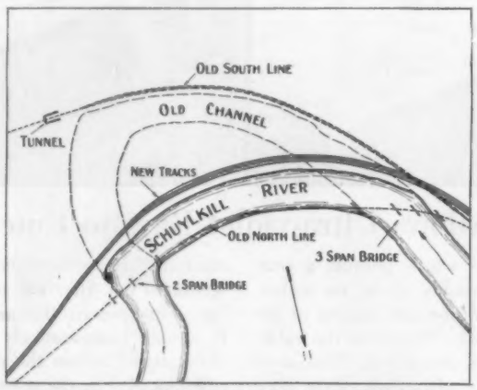


CHART SHOWING PORT CLINTON CUT-OFF

Old channel shown in dotted lines; new channel in full lines. In dotted lines also are the old south and north lines. The new double-track is shown in full lines

But, to the general public, the Reading Railroad is famous as operating, between Camden and Atlantic City, the fastest trains in the world. There is probably no stretch of railroad anywhere so admirably adapted to high speed on account of its physical characteristics, such as favorable grade and alignment. The maximum curvature on this stretch of 55.2 miles is three degrees, and the maximum grade is less than one foot in 100. The high quality of the track, as given above, is favorable for fast running. A southbound train encounters all the three-degree curves before having gone a distance of six miles, after which there is nothing sharper than a one-degree curve all the way to Atlantic City.

One Hundred Miles an Hour

We have received many letters asking information relative to the maximum speed ever attained by a railroad train, and whether a train can reach the hundred-mile-an-hour mark. In response to our inquiry, the Reading officials have furnished us with the following statement:

"The fastest time ever made from Camden to Atlantic City was in August, 1907, when train Number 25, made up of engine Number 348, one combination car, three coaches and a Pullman, made the run from Kaighns' Point Ferry, Camden, to Atlantic City in 42 minutes. The train left Camden at 3:58 P.M. and arrived in Atlantic City at 4:40 P.M. We do not have the time at intermediate stations, but in order to make the run in this time, it is safe to assume that the train exceeded 100 miles per hour between Egg Harbor and the Atlantic City meadows."

Because of the automobile congestion at the ferry

POWERFUL PACIFIC-TYPE EXPRESS LOCOMOTIVE

These locomotives haul the Camden-Atlantic City express, which formerly has reached 100 miles per hour and, today, under automatic train-control, often reaches 85 miles per hour, which is the maximum allowed

over the Delaware River, these trains sometimes leave from three to as high as seven minutes late; but such is the excellence of the road-bed and the great power of the type of engine now used, a photograph of which accompanies this article, that they always are able to make Atlantic City on time, and this in spite of the high scheduled running speed. Today, however, the line is equipped with an automatic train control, which holds the maximum train speed down to 85 miles per hour. Any train exceeding this speed immediately receives an automatic brake application. The high speed above referred to was made by an Atlantic-type, express locomotive, which, with its big boiler capacity and large-diameter driving wheels, was capable of extremely fast running.

But, returning to the Port Clinton Cut-off, we draw attention to the accompanying map which shows, in dotted lines, the old north and south tracks and the old river channel—the new channel and new tracks being shown in full lines. The pioneer road was single track, and when the location was being made, it was decided to build the line along the south bank of the river, tunnel through the hill, and then follow the course of the Schuylkill River southward toward Reading. The tunnel was built for a single track, and it necessitated boring through solid rock for a distance of 1,650 feet and lining the tunnel throughout with brick. This work was done about the year 1840.

Later, in 1874, to meet the increase of traffic, another main track was laid. No attempt was made to undertake the costly work of widening the tunnel, but, instead, the second track was located across the neck of the bend of the river, the first crossing of the river being made on a three-span bridge and the second on a bridge of two spans. The second line then ran east to a junction with the old south line. Both bridges were important structures for those days—the total lengths being 436 and 302 feet, respectively.

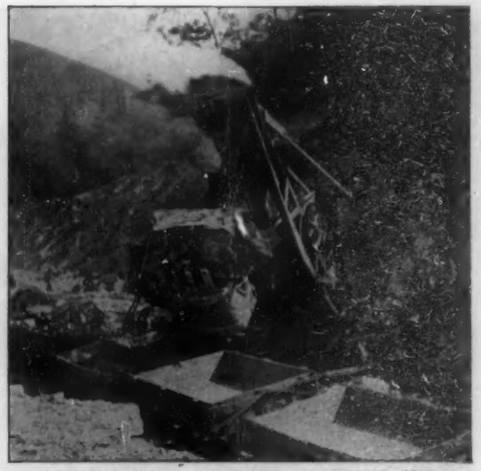
So far, so good; but the traffic continued to increase at such a rate and the rolling stock grew so greatly in power, size and weight, that for some years both the tunnel and the bridges had been taxed to their full capacity. The tunnel clearance became too restricted for much of the rolling stock, and one of the river bridges was calling for renewal.

A Bold Undertaking

The tunnel and the bridges had presented so many operating and maintenance disadvantages that the company decided to get rid of them altogether. The problem was solved by the very bold expedient of cutting a new channel for the river across the neck of the bend and building two dams across the bed of the old river, thereby diverting the Schuylkill River through the new and wider channel, 210 feet wide throughout its full length of about 2,000 feet. The separate north and south tracks were combined in a two-track line, laid upon the embankment formed by the excavated rock from the new channel. It was a bold undertaking, and reflects great credit on Samuel T. Wagner, Chief Engineer, Clark Dillenbeck, Assistant Chief Engineer of the railroad, who developed the plans, and William McCormick, Assistant Engineer, under whom the work has been successfully carried out.

The first thing to be done was to build dikes at both ends of the new channel to keep out the river during the excavation work. The taking out of the rock was rendered difficult by the fact that the channel had to be cut in what was mainly solid, flint-like, and exceptionally hard rock. In places this cut was as much as 60 feet deep, and consisted of about 18 feet of earth, about the same amount of loose rock, and then the solid mass of hard ledge-rock. The depth of the cut in this rock was from 20 to 30 feet, and to remove it the contractor had to expend about 56,000 pounds of explosives.

Four steam drills, four air drills and three gasoline-driven drills were used in putting down the blasting holes. To cope with the work and keep the drills (built of a special steel) in cutting shape, it was necessary to install a blacksmith shop and a compressed air and drill-sharpening plant, in which as many as 100 drill points were sharpened in a single day. The total amount of rock removed from the cut was about 275,000 yards.



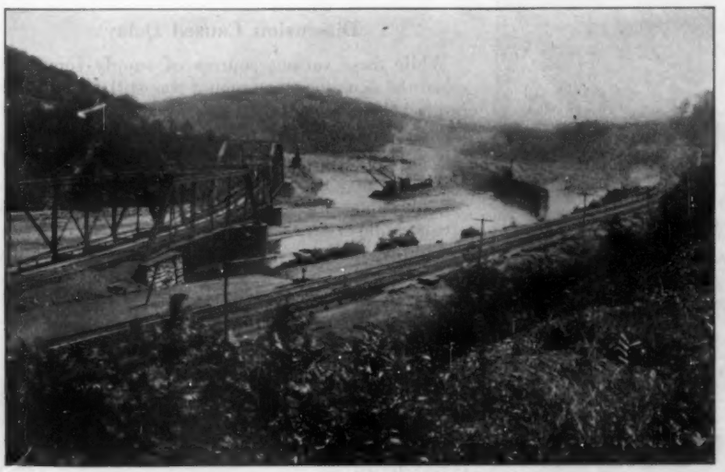
STEAM SHOVEL AT WORK IN HEAVY CUT

The new river channel and the deep approach cut were excavated through a vertical stratum of extraordinarily hard, flint-like rock of the kind shown in the shovel. Special drills were used to penetrate this rock

The location of the tracks on the south side of the new channel necessitated a deep and heavy rock cut along the northerly toe of the hill through which ran the now abandoned south-line tunnel. This cut, which is of varying depth, reaching a maximum of 50 feet, is about half a mile in length. It included approximately 75,000 cubic yards, mainly solid rock, part of which was used in making the embankment on the south shore of the new river channel. The new tracks were laid on this embankment.

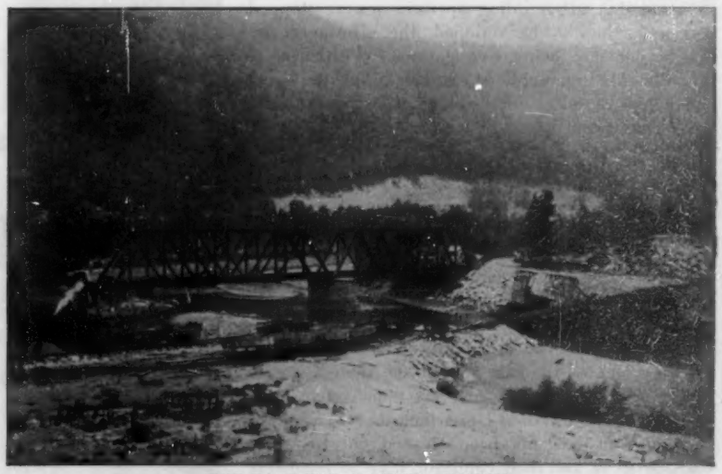
In view of the fact that all of this unusual construction had to be carried through without interfering with the heavy traffic on this part of the main line, it was necessary to plan the sequence of operations with great care. Every move had to be made in its proper order, since a false move would have caused intolerable confusion and delay to the traffic, as well as heavy expense to the operators of the railroad.

Huge electromagnets, hung on chains from overhead supports, find various uses in different phases of present-day industry. Many of these uses will be described and illustrated in a future issue of this magazine.



VIEW AT WEST END OF NEW CHANNEL

AT LEFT: *the three-span bridge across the Schuylkill River which was removed after new channel was completed.* CENTER: *dyke being built to shut out the river from new channel excavation.* RIGHT: *the old channel and old south line, now abandoned*



THE EAST END OF NEW CHANNEL

RIGHT: *the new channel, and the dyke (shown under construction) to cut off old channel.* CENTER: *two-span bridge carrying old north line, later removed. Note construction of trestle from which the embankment material to cut off the wake of old channel was dumped*

THE NEW ROAD TO AIN FARAH

The Psalmist's well in the Ain Farah gorge is now reached by a new and precipitous road, extending seven miles from Jerusalem and dropping about 1,200 feet in that distance

MODERN TRUCK AT THE ANCIENT WELL

The old and the new methods of travel. The truck at the left brought the machinery to the well. The donkey is still a popular and a convenient means of transportation

Psalmist's Spring to Supply Jerusalem with Water

How the Problem of an Efficient Water-supply for the Holy City Is Being Solved by the Establishment of Modern Water Works on the Spot Associated with the 23rd Psalm

By Harold J. Shepstone, F.R.G.S.

THE tapping of the spring in the Ain Farah gorge with a view to increasing the water supply of Jerusalem, calls attention not only to this historic gathering place of the shepherds of Palestine among the hills of Judea, but to the vexatious problem of how to provide an efficient water supply for the Holy City.

Ever since the British took over the city from the Turks they have been harassed over this question of water. This is remarkable when it is remembered that Jerusalem has a population of nearly 70,000, is one of the oldest cities in the world and has enjoyed the beneficent rule of some of the most powerful and highly civilized empires the world has known. Yet last summer the shortage of water was so acute that all building operations were stopped and water had to be rationed, the allowance per family per day being five gallons. Furthermore, this was only obtainable on six days out of the seven and it had to suffice for drinking, cooking, washing and cleaning purposes.

Water at 50 Cents a Bucket

The reason for this apparent neglect of the city's water is due to a combination of causes. When, as a result of the World War, Jerusalem was taken over from the Turks, it was entirely dependent upon the rainfall for its supply of water. This was caught during the rainy season on the flat roofs of the dwellings and stored in underground cisterns until needed. One of the first acts of the British was to clean out these cisterns, some six thousand in number, repair, number and cover them over. Some of these cisterns had not been cleaned out for forty years or more and their condition may be imagined.

Even under the Turks, Jerusalem knew what it was to run short of water. If the amount of rain fell below normal, a shortage was sure to follow. The writer has known the time when water has been sold in the Holy City at fifty cents a bucket. But on the coming of the British, the Jews began to return in large numbers to the city of their forefathers and it was evident to all that something must be done to increase the water supply.

So British engineers went to the Virgin's Fountain, just outside of the city. This is a spring, but inclined to run dry in the summer months. They sunk a well here and managed to increase the flow. Then some fifteen miles south of the city an old reservoir, known as Birkett Arroub, built by Pontius Pilate over 2,000 years ago, was repaired and from this point water was pumped to the city, the capacity of the reservoir being some five million gallons.

ENGINEERS MEASURING FLOW OF SPRING

The first step at the pumping station was to measure the daily flow of water from the spring

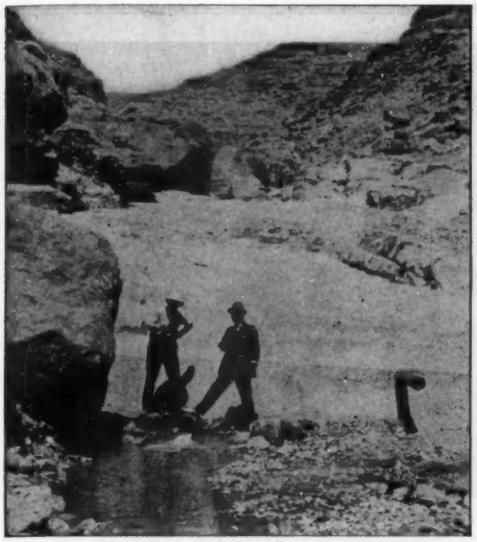
Those ancient reservoirs known as the Pools of Solomon, lying to the south of Bethlehem, and said to have been built by Solomon, were also repaired. In Roman times water was brought from these old pools to the Holy City by means of an aqueduct. But under the Turkish regime the aqueduct was allowed to fall into decay and has long since disappeared. Thus it is rather strange to find that in Roman times, Jerusalem was not entirely dependent upon the rainfall for its water as it was for many centuries under the Turks.

Dissension Caused Delay

While these various sources of supply somewhat eased the situation, the amount was still found to be insufficient, due largely to the rapid increase of the population and to the abnormally small rainfalls. It was at this period that the Palestine Government was presented with a claim from a Greek subject, Mr. Mavromatis, declaring that he had been granted a concession from the Turkish Government not only to supply Jerusalem with water, but to provide a sewage system as well. His claim being ignored, the Greek Government took the matter to the Hague Tribunal. This meant that all plans for increasing the existing water supply of the city were temporarily shelved.

The Tribunal found that the Greek concession still held good, but declared it could not recommend any award for damages as no plant had been built or outlay incurred.

Mr. Mavromatis' plan was to pump water up from the River Jordan, a costly proposition, and as he was not prepared to undertake the task and because



AT THE HEAD OF THE SPRING

The head of the spring is enclosed with concrete to render the water safe from contamination

the authorities in Jerusalem did not look upon it with favor, nothing was done.

The acute shortage of water last summer, however, brought matters to a head. It was very necessary first to relieve the then existing situation and also to take steps to ensure a more efficient supply in the future. The nearest point from which water could be economically obtained was from the Urtas Springs, near Hebron. Accordingly the government passed an ordinance giving powers to the Jerusalem Water Board to take water from these springs on the distinct understanding that sufficient was to be left for the daily needs of the villagers and their cattle. But the villagers strongly objected to this onslaught upon their water-supply and took the matter to the High Court in Jerusalem with the result that judgment was given against the government.

The officials had no option then but to apply to the Foreign Office in London for the requisite power which, needless to say, was granted. As a result some 80,000 gallons of the precious liquid were brought to the city daily from the Urtas Springs by rail, the cost of the required transportation alone reaching the large total of over 1,000 dollars a day.

Mavromatis' plans were now more carefully considered and at a conference between him and the engineers in Jerusalem it was agreed that while eventually it may be necessary to tap the Jordan, the harnessing of the spring in the Ain Farah gorge could be made a stepping stone in that direction. This spring lies some 1,200 feet below Jerusalem in a wild ravine among the hills of Judea some six or seven miles to the northeast of the Holy City, whereas the Jordan, which is some fifteen miles from Jerusalem as the crow flies, lies 3,392 feet below the city. The raising of water from such a depth would entail the establishment of a series of pumping stations at varying elevations, and that at Ain Farah could be made one of them.

Where Shepherds Water Their Flocks

At any rate, the work of harnessing the spring and erecting the necessary pumping station was entrusted to the firm of Sir John Jackson, of London, and the work is now well in hand and Jerusalem is assured of an efficient water supply.

One of the first tasks of the engineers was to build a roadway down the gorge. On account of its steepness and the wild character of the country this proved no easy feat. It called for a great deal of blasting and the construction of many hair-pin bends.

Starting close to the War Cemetery on the Nablous Road, the roadway runs to the little mud village of Anata, which corresponds to the ancient Anathoth, the birthplace of Jeremiah. From this point one can detect the blue waters of the Dead Sea and the bed of the Jordan away to the east between barren and desolate mountains. The descent to the spring from this point is certainly steep, for one is going down, down all the time.

The spring itself gushes out from a mass of broken rocks and then flows for a considerable distance through the ravine, turning it into a delightful oasis. From time immemorial the gorge has been the gathering place of the shepherds of Palestine. This wild spot is associated with the 23rd Psalm, for here, David is said to have spent his boyhood days tending the sheep and it was the experience he gained here as a shepherd that led him to pen the Psalm, "The Lord is my shepherd . . ."

The writer will not readily forget the picture these sturdy sons of the hillsides, dressed in camel-

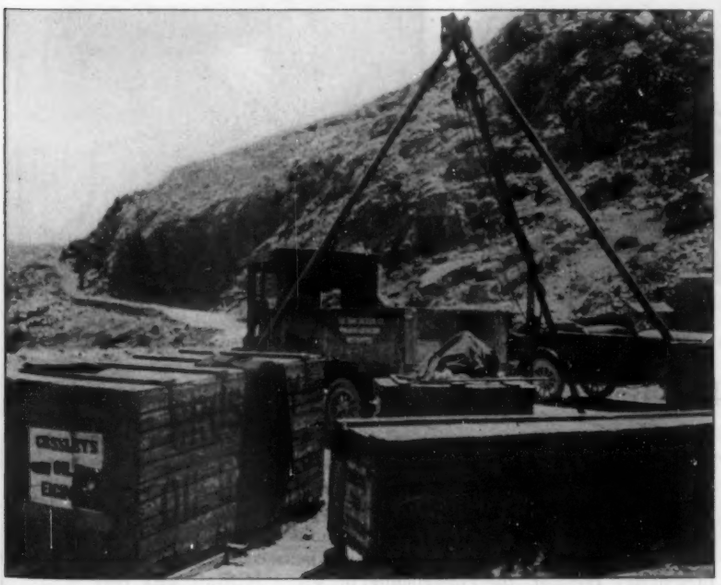
ROAD SIGN IN THREE LANGUAGES

At this point, the new road branches off from the Nablous Road near the city of Jerusalem

hair cloaks of bright colors and white kerchiefs with black bands on their heads, present as they wend their way down the steep mountain tracks followed by their flocks of sheep and goats. Here they water their charges, rest from the noonday heat in the shadow of the rocks, and then as the sun begins to decline they ascend the gorge again to their pastures.

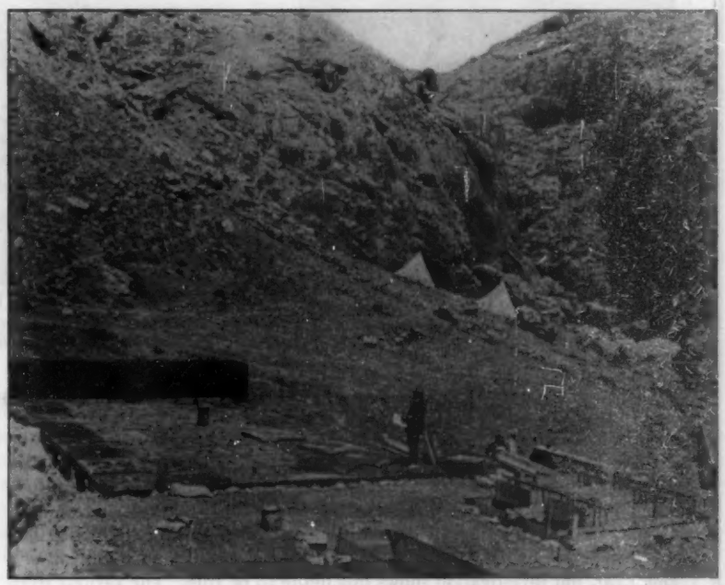
The spring has now been enclosed and modern water works erected on the site. Halfway up the gorge, too, a second pumping station has been installed. The work in fact is now well in hand and before long Jerusalem will be able to rely on 200,000 gallons of water daily from the Psalmist's spring. But the engineers have arranged for water to still flow through the gorge and the shepherds will continue to gather here as they have done from time immemorial.

Recent experiments with minute currents of electricity conducted by wood have revealed some unusual results, especially in the field of burglar alarms. An illustrated article in an early issue will describe the details of the system.



PUMPING MACHINERY AT THE SPRING

All machinery and supplies were brought in over the new road through Ain Farah gorge. Jerusalem can soon rely on 200,000 gallons of water from the Psalmist's well



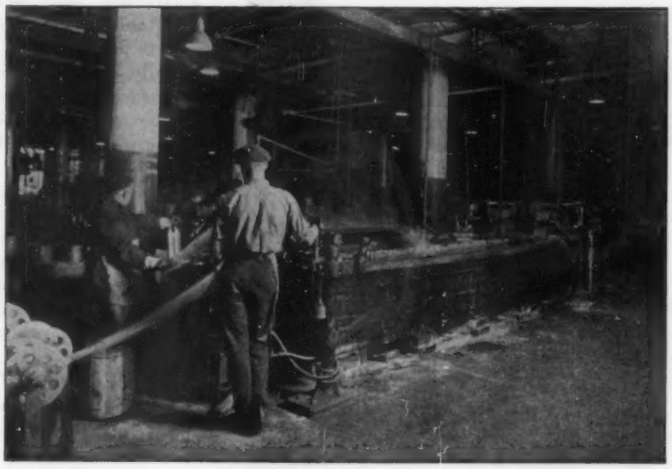
A STEEL COLLECTING-POOL

At this historic gathering place of the shepherds, Sir John Jackson's engineers are shown constructing a tank to impound the water at the lowest pumping station

All photographs courtesy Harrison Radiator Corporation

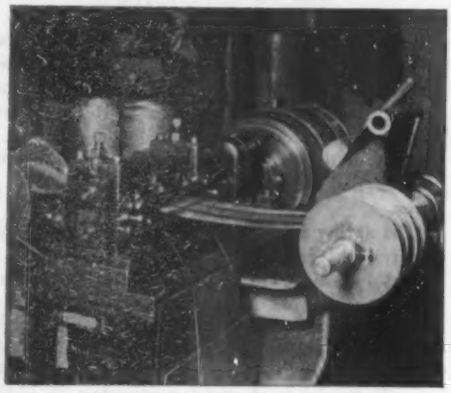
IN THE ROLLING MILL

Here the brass that is to be used in the core construction is annealed. This photograph shows the metal being removed from the furnace



PICKLING THE METAL

Before the brass strip is used in the assembly of a radiator core, it must be thoroughly cleaned in a pickling vat such as that shown above



PREPARING THE CORE STOCK

After the brass is rolled to the required thickness, it is slit lengthwise and rolled on cores

CRIMPING THE OUTER CORE-STRIPS

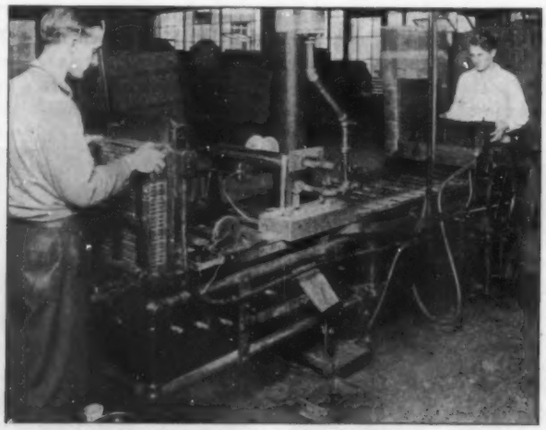
This machine puts the proper crimp in the strips that form the outside of the honeycomb structure

TRIMMING THE ENDS OF THE STRIPS

In order to insure the proper fit in the final assembly, the outside core-strips are trimmed square

FOLDING THE STRIPS

In this step of the process, the outside core-strips are folded to the proper length



AUTOMATIC SOLDERING MACHINE

Here the sections are treated with flux and then dipped into the molten solder to a certain predetermined depth

THE INTERMEDIATE STRIP

The two pleated outside strips are separated by the specially crimped intermediate one

How Is Your Automobile Radiator Made?

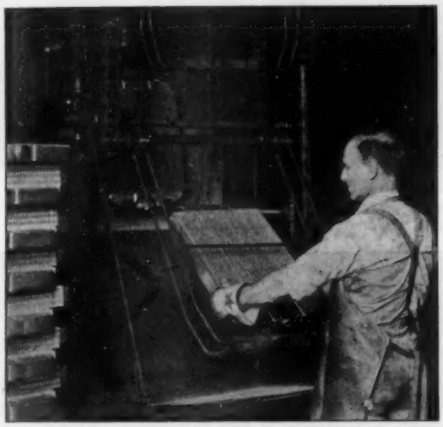
Although the radiator is an essential part of every water-cooled automobile, still the average owner gives it little thought, other than the addition of an occasional quantity of water. The only time that he actually feels concerned about it is when cold weather sets in suddenly and the neglected radiator freezes. Upon casual consideration it hardly seems possible that more than 2,000 steps are required in the construction of a quality radiator for even a small car, but investigation shows this figure to be true. The various illustrations on this and the opposite page show only a few of the operations, but they serve to illustrate some of the machinery that makes rapid construction possible, and hence reduces the cost to the ultimate consumer. Speaking historically, there have been three distinct types of radiators in general use. The first consisted, and this type is still in use, of a series of copper tubes connecting top and bottom tanks and equipped with fins or disks to facilitate cooling. The second type was the forerunner of the present-day radiator, the construction of which is dealt with here, and consisted of thousands of square copper tubes, one-quarter of an inch on a

THE CORE-UNIT DIPPING FRAME

The sections of the core are stacked on this frame preparatory to being soldered together, whereupon the core will be nearly completed

WHERE THE CORES ARE SOLDERED

The entire soldering process, as far as the core is concerned, is automatic. The assembly passes through the molten solder on a conveyor



WASHING THE SOLDERED CORES

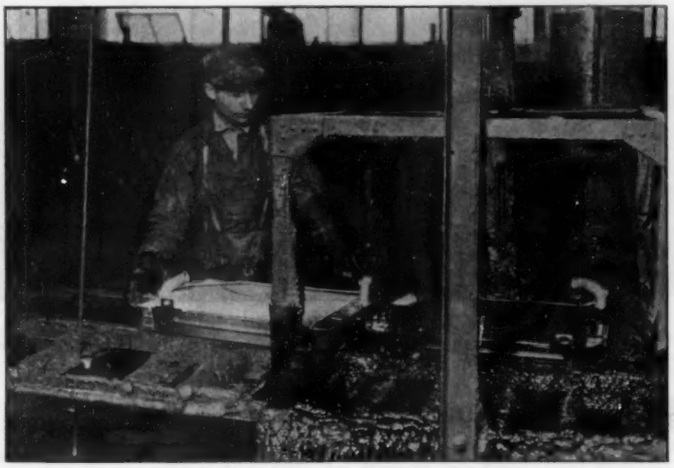
To insure the removal of all dirt and superfluous flux, the cores are washed in three baths

THE TANKS ARE SOLDERED ON

Each radiator has a tank at the top and another at the bottom, soldered in place as shown

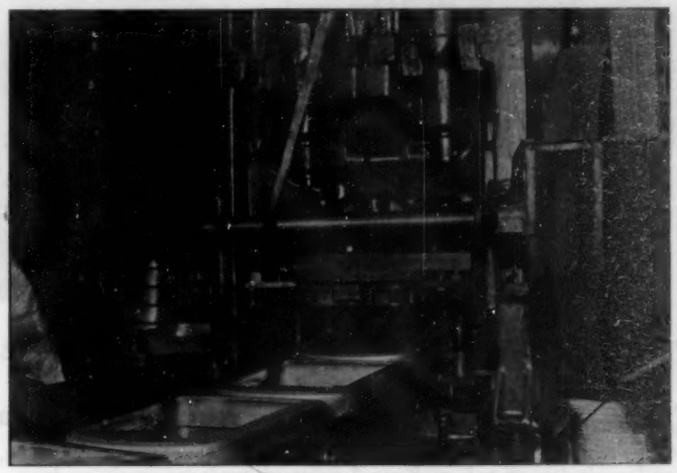
TESTING FOR DEFECTS

With the core under water, compressed air is used to detect small holes which may be present



PAINTING THE CORE ASSEMBLIES

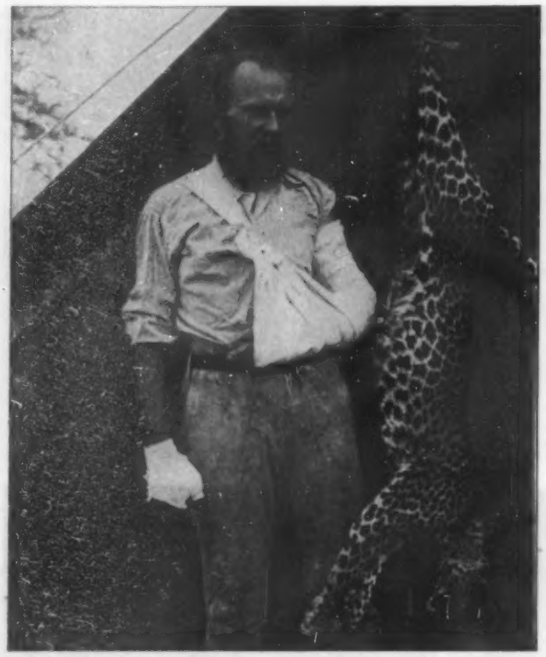
By dipping the completed cores in a special paint, assurance is had that all of the surfaces will be coated thoroughly and hence protected



PUNCHING THE RADIATOR SHELLS

The shells or casings are stamped from heavy aluminum. The press in the above photograph serves to punch out the center of the shell

side and four inches long, nested horizontally and separated in both directions by lengths of wire. The block so formed was dipped in solder and then assembled with top and bottom reservoirs. The water was forced to pass around the square copper tubes and the cooling air passed through the centers of the tubes. This method of construction was costly, the final radiator was fragile, despite its great weight, and it was likely to clog because of the small water passages. The third type was mounted on the dash and was merely a series of soft copper tubes connecting the usual top and bottom tanks. The air was circulated around these tubes from the sides as well as from the front. All of these methods of construction needed simplification and as a result, the honeycomb radiator core was designed. In this type, brass strips one five-thousandths of an inch thick are crimped and pleated in such a manner that when an intermediate crimped strip is placed between two others, a series of two layers of hexagonal air passages is formed. By placing these units side by side and soldering the faces, a light yet strong and rigid honeycomb structure is formed. The crimping of the layers provides ample passages for water and the thin metal and the method of construction insures rapid cooling.



THE VICTORY WAS NOT A BLOODLESS ONE

Akeley killed this leopard bare-handed on his first expedition. He grimly called this photograph "First and Second Money"

AN AFRICAN IDYL

A herd of graceful "impalla" antelope drinking at the water's edge in British East Africa. The animals are very shy and fear lions. Therefore they only drink after sun-up

All photographs courtesy of the American Museum of Natural History

A NATIVE-MADE ROAD IN UGANDA

The native road was originally a path. When white officials came, they had the natives cut the brush and make a road for cycling and automobiling

A LEOPARD SPEARED BY THE NATIVES

Akeley was taking pictures of natives spearing lions when a few leopards were also captured. This one was transfixed by two spears and a knife

Carl E. Akeley—Naturalist, Explorer and Inventor

The name of Carl E. Akeley will ever remain one of the brightest in the history of American science. We can only compare him with those Titans of the Renaissance, Leonardo da Vinci and Michelangelo, for like them he was a superman. It is difficult to tell whether he was a better sculptor than he was a naturalist or inventor, for in all three he was preeminent. In the art of taxidermy, he completely upset the old "upholstery" idea where an animal's skin was hung up and filled with sawdust until no more could be forced in when the hide was sewed up. Akeley died in the Belgian Congo on November 17, 1926, and was buried on the slopes of Mt. Mikeno in the middle of the gorilla sanctuary which he helped to create. He is buried on the spot where he said he would like to be. While the loss of this great leader is a severe blow to the American Museum of Natural History, still his work for the great African Hall of the Museum will be carried on by his widow, an African explorer of note. Our illustrations show some African scenes. All are from Akeley's negatives and all were made by him except the first. Carl E. Akeley was born on May 19, 1864. From boyhood, he had a great taste for taxidermy and became so experienced in the work that in 1895 he was engaged by the Field Museum of Chicago. He remained there until 1909, when he joined the staff of the American Museum of Natural History in New York, where he continued his work until death. Before all else, Akeley considered himself a taxidermist, which art he virtually re-created. He was by far the best taxidermist of this age. He combined a technique of character with flawlessness in workmanship, and mounted skins that will last for many years so that the subject will become an historical fact when the animal life it represents has been wiped out by civilization. Akeley made five trips to Africa to procure specimens of the big game of that continent for exhibition. He has made a special study of the gorilla and, foreseeing the extermination

JUNGLE ON SLOPES OF MOUNT KENIA

The stones and trees are covered with moss; ferns are waist high, while thick trees make progress almost impossible

A SCULPTURED-MUD GRANARY COVERED WITH THATCH

The function of the granary is to keep the grain away from ants, rats and other pests. The attempt at sculpture is crude, but indicates a desire for artistic expression

All photographs courtesy of the American Museum of Natural History

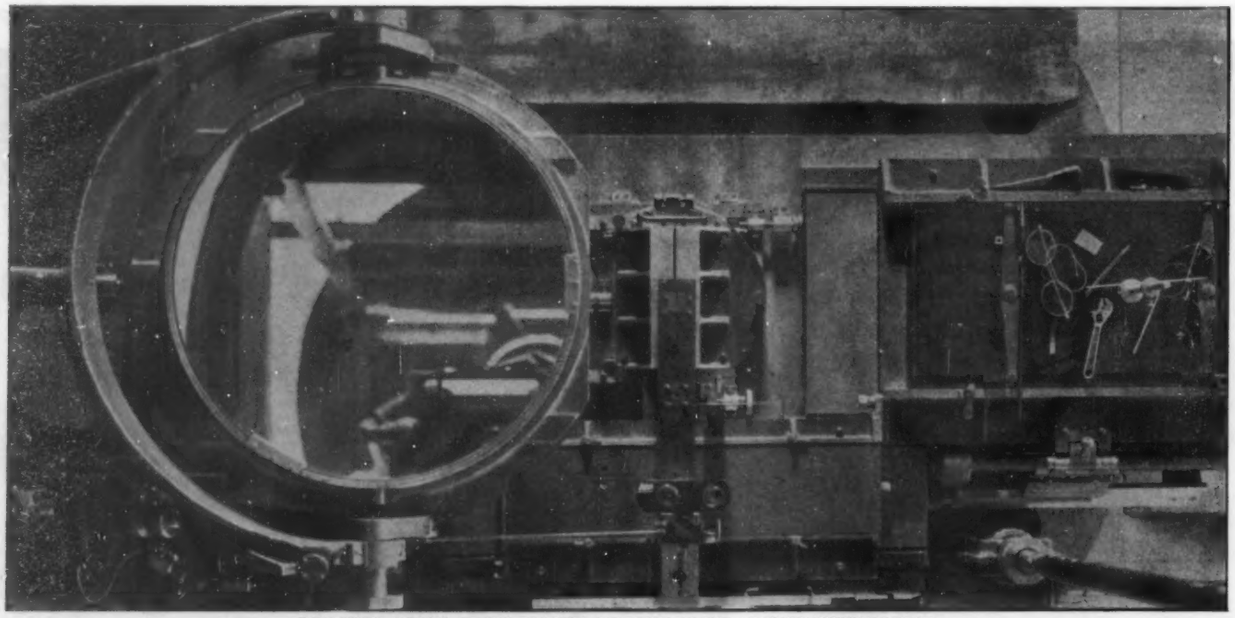
BRINGING HOME THE IVORY

A scene in Uganda where natives are bringing out Congo ivory. Tusks, or "points" as they are called, weigh 60 pounds or over. Natives are proud to carry the tusks. Others are carrying provisions

OSTRICH DECOY FOR PHOTOGRAPHY

Photographers of wild animals often fabricate decoy animals which enable them to approach their quarry

of the wild life of Africa, conceived the idea of the establishment of a gorilla sanctuary where the remnant of these splendid animals might be saved from reckless slaughter. The Belgian Government approved Akeley's suggestion and on March 2, 1925, his Majesty, the King of the Belgians, by royal decree, created the Parc Nacional Albert as an absolute sanctuary for all wild life within its confines. This sanctuary comprises 250 square miles in the Lake Kivu district. It is situated in the northeastern part of the Belgian Congo between Lake Kivu and Uganda and includes three volcanoes—Mt. Mikeno, Mt. Kirisimbi and Mt. Viscke. It was in this home of the gorillas, which he studied and loved, that he died. The cherished dream of Akeley's life was an African Hall of the American Museum of Natural History in which would be displayed a comprehensive collection of the animal life of his beloved Africa. As planned, this wing is to be a great open hall, unobstructed either by supporting columns or exhibition cases. Habitat groups in hermetically sealed glass cases are to line the sides of the hall on two levels. Twenty of these, containing the larger game animals of Africa, will be viewed from the main floor, while, in an equal number of cases, the smaller animals will be viewed from the gallery. Scenes from the life of the African native will be shown in a series of bas-relief panels placed about the entire lower floor, just beneath the gallery. For this hall, Akeley completed several large mounted and sculptured groups. The dominating piece, in the center of the hall, will be a group of four elephants, one shot by former President Theodore Roosevelt, one by Kermit Roosevelt and two by Akeley. Akeley was a sculptor of note, and in addition to his various other pursuits, he was the inventor of the cement gun and of the famous Akeley moving-picture camera. During the great war, he served as consulting engineer of the Division of Investigation, Research and Development, Engineering Department, United States Army, and as special assistant of the Concrete Department, Emergency Fleet Corporation. He superintended the construction of concrete ships, using his cement gun, which mixes cement, sand and water in the nozzle. He also invented several improvements on searchlights.



LOOKING DOWN FROM ABOVE ON THE HALE SPECTROHELIOSCOPE

The two oscillating slits near the center are the essential parts. Below them is the binocular eyepiece. The eighteen-inch concave mirror gathers the light

Solar Whirlwinds Made Visible

The New Hale Spectrohelioscope Provides "Eyes" for the Previously "Sunblind" Astronomer

By Lee McCrae

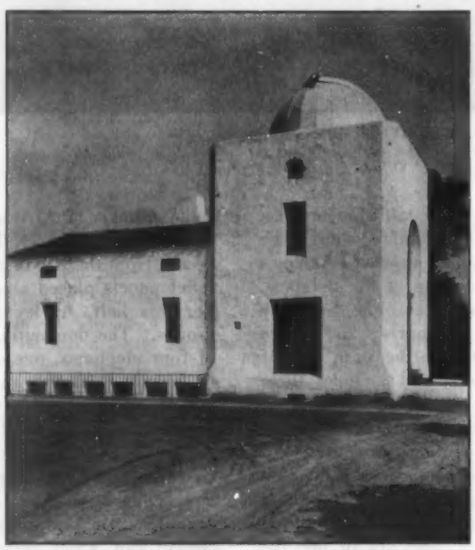
AN apparatus called the spectrohelioscope, which stands in somewhat the same relation with the spectroheliograph that motion pictures stand with regard to still pictures, has been invented and put into use by Dr. George Ellery Hale, Director of the Mount Wilson Observatory near Pasadena, California.

Formerly, when the astronomer looked at or photographed the sun's disk by means of the spectroheliograph, the vast whirlwind movements called sunspots, taking place in various layers of incandescent gases, could not be followed visually. The chances of happening to hit on the right moment to make the exposure of a plate in monochromatic light that would reveal them were comparable to those of a blind man, unaided by hearing, hitting on the right moment to photograph earthly events with a camera. The new spectrohelioscope now provides eyes for the "sunblind" astronomer: with it he can look directly at the turmoil of a vast solar whirlwind and watch the gradual progress of events in its several layers.

Forty years ago Dr. Hale began a series of photographic and visual studies of the sun. About 1891 he perfected the spectroheliograph, by means of which photographs in monochromatic or "one-colored" light might be taken for the leisurely study of astronomers everywhere. His solar towers on Mount Wilson, California, one of which is equipped with this device, have been sources of information to all the world. The spectroheliograph, in addition to providing a method of photographing the chromosphere and prominences at the sun's limb or edge, has made possible the daily study of the solar atmosphere in projection against the disk.

Each of these photographs, however, requires several minutes for its exposure, and the work heretofore has been done blindly, without knowledge of the critical moments at which the most striking and significant phenomena rush through their changing phases. Hence, impelled by the need of a similar means of visual observation, Dr. Hale has gone on until he has now perfected the spectrohelioscope which enables the human eye to do constant research work independent of the camera-lens.

Our illustration shows the instrument as one would look down upon it. An image of a portion of the sun's disk is observed through a rapidly oscillating slit, set upon a single line of the spectrum, usually the red line of hydrogen. In its adjustment to its purpose, it is simplicity itself. By means of it, Dr. Hale and his assistants now watch the behavior of the whirlwinds of hydrogen around the sunspots, as well as other fascinating phenomena. As the wavelength of the light from hydrogen varies with its velocity, Dr. Hale has devised a means of changing instantly the position of the line on the oscillating slit and bringing into view enormous masses of gas which are not recorded by the spectroheliograph because of the velocity of their approach or recession.



DR. HALE'S SOLAR LABORATORY

Here, in Pasadena, the spectrohelioscope was perfected. It is so simple that the amateur may construct it

As a means of exploring the entire solar atmosphere quickly and effectively, the spectrohelioscope is unrivalled. In a few minutes one may run completely around the limb, inspecting not only the chromosphere and prominences projecting beyond it, but also, with equal ease, those which extend on to the disk and appear there as bright or dark masses. Besides the forms and changes which it reveals, the spectrohelioscope measures the velocity of moving gases and has thus led quickly to important advances in our knowledge of the great whirlwinds that center over sunspots.

One of its services is that of a "scouting" auxiliary to the old photographing process. Instead of blindly setting the spectroheliograph and laboriously and expensively recording whatever its lens might find, observers now are able to select the most interesting regions for study where eruptions, vortices and other active phenomena are occurring. Thus, the spectrohelioscope is invaluable simply as a guiding device for the older instrument. But it is even more useful because of the new phenomena which it reveals and because of the means it provides for their immediate interpretation.

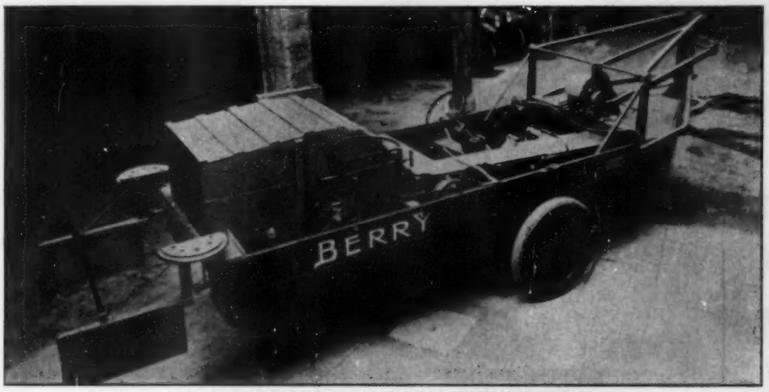
It gives a speed of operation hitherto lacking in solar research, and consequently it is of great service in detecting and following violent outbursts on the sun. It should therefore help to establish the true relationship between these eruptions and terrestrial magnetic storms and auroras.

The instrument, as pictured here, is combined with a large spectroscope and spectroheliograph. But Dr. Hale is trying to produce a simplified form which shall be inexpensive and suitable for use by amateurs, for, if there can be continuous and simultaneous observation of the sun around the world, there will be instant detection of any outbursts on it, and therefore a better chance of learning their effect on terrestrial magnetism.

All photographs by National Feature Photos

THE ANNOT SWAMP-GRASS CUTTING MACHINE

This device performs the work of cutting the weeds close to the bottom of the pools and then gathering the clipped grasses with a raking motion and bringing them to the surface



AN AMPHIBIOUS SWAMP-RECLAIMING DEVICE

This machine also uses a combination cutter and rake. It is so built that it can be run either in the water or on land. It is said that with the use of this device 100 acres per day can be cleared

CUTS TWO SWATHS AT ONCE

This type of grass cutter for swamps can be used, when near the shore, not only to cut the grasses on the bottoms of the pools, but by means of an arm and cutter, to clip the banks as well

THE ANNOT DEVICE IN ACTION

This photograph shows the machine with a load of grass. This is towed to the bank where it is disposed of, thus clearing the water of obstructions

A DISK TYPE OF CUTTER

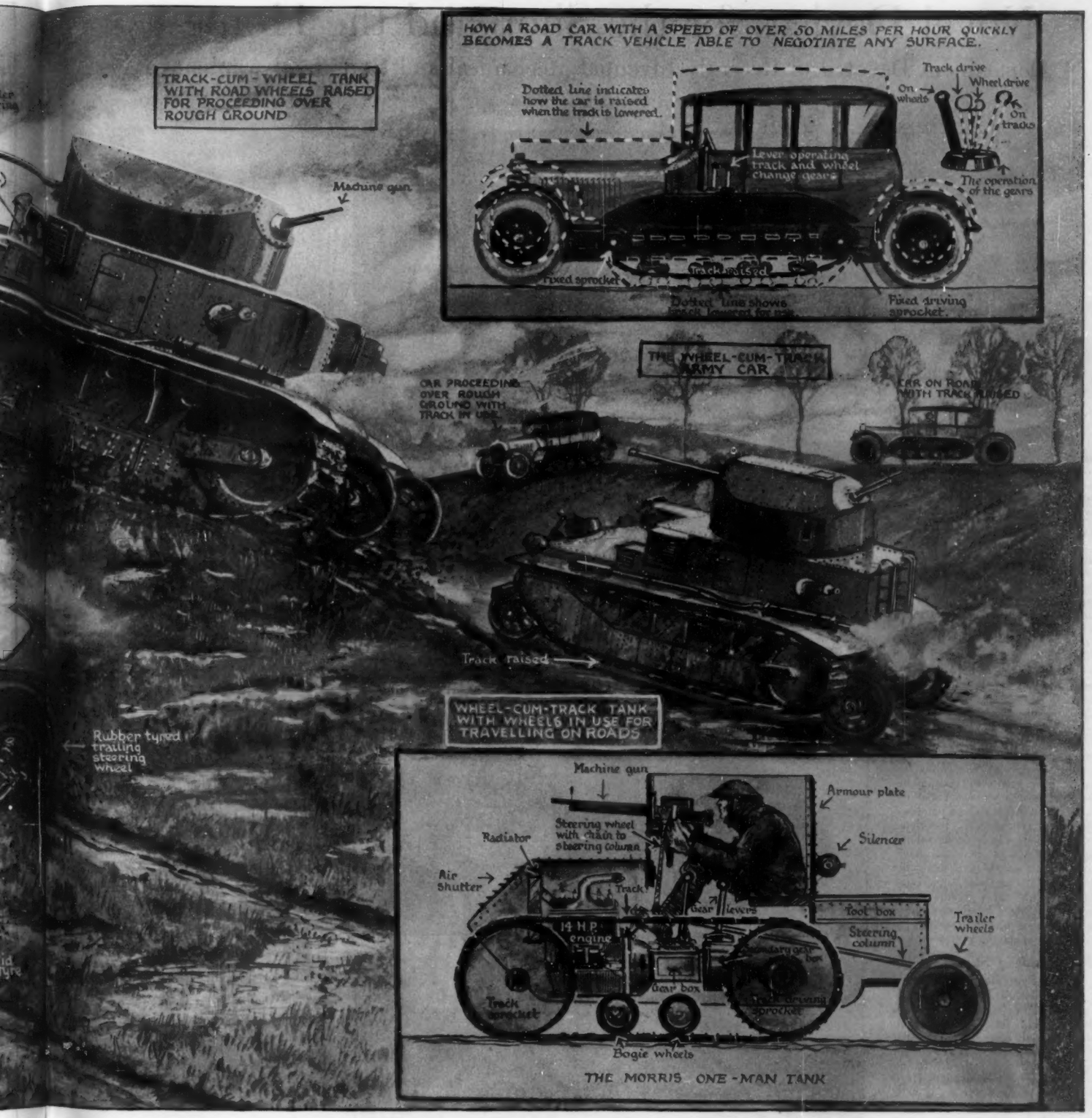
The disk with a sharpened edge is driven by a hand crank. The position is governed by the long shaft. Insert shows a close-up of the disk

Swamps Reclaimed by Weed-cutting Machines

In an effort to reclaim some of the millions of acres of swamp land in France, several machines have been devised which can be used for cutting the weeds far below the surface, close to the bottom. The idea underlying the use of these cutters is that the pools and small lakes which can be cleared of the growths may then be used for fish hatcheries. It has been found that the thick masses of rushes and grass prevent fish from living in the waters of many lakes and ponds and render the water fit only for the breeding of mosquito larvae and other annoying pests. When these bodies of water have been cleared of their growth, the water will not become stagnant, small boats can navigate successfully and thousands of fish can be raised. The problem of removing the heavy growths of swamp grasses was attacked from the angle of using portable cutters mounted on small boats. Our photographs show four different types. In some, the boat and cutter are both to be manipulated by hand. In others, a small motor of five to six horsepower furnishes the necessary power. The majority of these boats can be handled by two men—one to tend the motor and the other to work the cutter. In the machine which makes use of a device resembling a huge barber's clippers, the grasses are raked together as they are cut. In a test demonstration, 100 acres were cleared in one day. According to reports, these cutting methods are very effective. It is said that after two or three cuttings, the weeds and grasses are completely killed and will not grow again. With the obstructions removed and fish introduced, the task of eliminating the mosquitoes is greatly simplified. The machine method of cutting the weeds has been adopted after attempts to remove them by hand had proved too costly. The value of fish that could be raised in the areas reclaimed by hand would not compensate for the cost.

New British Tanks, Field Artillery, and Military Cars

When the Germans saw the British advancing in the great drive which has come to be known as the Battle of the Somme, they experienced the greatest surprise of the whole war. Moving ponderously forward, ahead of the advancing infantry, they saw a long line of what looked, for all the world, like huge antediluvian monsters, minus head, tail or feet, which came lurching forward, overturning trees, crashing through stone walls, bursting through parapets and trenches, and belching forth fire, bullets and bursting shells. Machine-guns and rifle-fire failed to stop the oncoming monsters. Small blame to the bewildered infantryman, if he preferred flight to an untimely death beneath these steel-clad juggernauts. Not all of the troops fled; some remained and tried to fire through the portholes, or climbed on the tanks, vainly trying to find a way in. It is a far cry from that day to this, and the crude tank of 1916 has been refined and improved until it shows, in 1927, a score of variations, as the above illustration serves to reveal. The latest developments in tanks, which a few weeks ago were shown to the Dominion Premiers assembled in London for the Imperial Conference, are believed to prove that in this type of warfare the British are still pre-eminent. Certainly, no other country, unless it be the United States, has devoted so much time and thought to the development of this new and powerful offensive weapon. This effort has resulted in the production of some very effective tanks, showing much originality in their design. The new "hush-hush" heavy tank, with its turrets mounting a three-pound quick-


HOW A ROAD CAR WITH A SPEED OF OVER 50 MILES PER HOUR QUICKLY BECOMES A TRACK VEHICLE ABLE TO NEGOTIATE ANY SURFACE.
Dotted line indicates how the car is raised when the track is lowered.
Track drive
Wheel drive
On wheels
On tracks
Lever operating track and wheel change gears
The operation of the gears
Fixed sprocket
Track raised
Dotted line shows track lowered for use
Fixed driving sprocket.
TRACK-CUM-WHEEL TANK WITH ROAD WHEELS RAISED FOR PROCEEDING OVER ROUGH GROUND
Machine gun
THE WHEEL-CUM-TRACK ARMY CAR
CAR PROCEEDING OVER ROUGH GROUND WITH TRACK IN USE
CAR ON ROAD WITH TRACK RAISED
Track raised
WHEEL-CUM-TRACK TANK WITH WHEELS IN USE FOR TRAVELLING ON ROADS
Rubber tyred trailing steering wheel
Machine gun
Armour plate
Steering wheel with chain to steering column
Radiator
Silencer
Air Shutter
Track
Gear levers
Tool box
Trailer wheels
14 H.P. engine
Steering column
Gear box
Track sprocket
Bogie wheels
THE MORRIS ONE-MAN TANK

Cars with Road Wheels, and with Tracks for Rough Ground

firer and numerous machine guns, created a great sensation as it rushed at high speed over the muddy ground. By the courtesy of *The Illustrated London News*, we are able to illustrate some types of the one-man tank, the new track-cum-wheel tank and the wheel-cum-track Army car, and also to show the latest developments in mechanized field artillery. The one-man tank is still more or less in the experimental stage, but eventually, the British expect to have squadrons of these little machines that will replace the cavalry of today. The artillery "dragon," with its 18-pounder field gun, gives some idea of what the field artillery of tomorrow will look like; with a speed of fifteen to twenty miles an hour they will give a new meaning to the phrase, "forward the guns!" No longer will straining teams of horses drag the clumsy, wheeled limbers and guns through the mud, but the "track" will rush gun and crew over or through obstacles impossible of negotiation by horse-drawn guns. The operation of the guns of the track-cum-wheel tank is naturally of a confidential nature, but we may say that, by the simple movement of a gear lever, the wheels are lowered and the tank, or rather its tracks, lifted off the ground. The wheel-cum-track Army car is just as simple to operate. The Morris tank is driven by a 14-horsepower gasoline motor. All these track vehicles have considerable speed over the worst surface, and their development is being encouraged by the British War Office, which has other types of military "track-propelled vehicles," including "dragons" and tanks carrying bridging equipment.

Novel Devices for the Shop and the Home

A Department Devoted to Recently Invented Mechanical and Household Appliances

Conducted by Albert A. Hopkins

Cross-section of a radiator valve

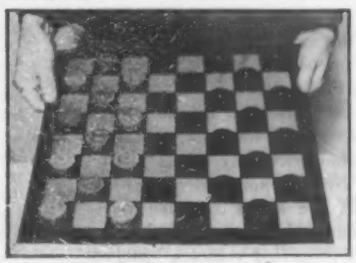
Vacuum-valve for Radiators

WITH the aid of the valve illustrated, a one-pipe steam system may be "vacuumized." A plant distributing hot vapor under vacuum conditions is obtained by merely changing to the venting valve shown. The casing is cut away to illustrate the mechanism.

The normal venting port through which air escapes is wide open until steam comes in contact with the float. Then the heat-sensitive fluid in the float, the thermostatic member, is changed to a gaseous state, whereupon it expands the float diaphragm, raising the float and closing the vent port. If the radiator is shut off, or for any reason the flow of steam ceases, the diaphragm contracts, and the float drops. But no air can re-enter the valve because the air check makes the port one-way—air can go out but none can come back. So, with the continuation of the condensation of steam and the prevention of air return, a vacuum is formed in the system. Air pressure in the room, exerted through a port, causes the diaphragm to lift the float and keep the ports closed. In other words, the air check prevents the return of air for a short period until the vacuum formed in the valve permits atmospheric pressure, acting through a port, to force the diaphragm upward, raising the float and doubly closing the vent port.

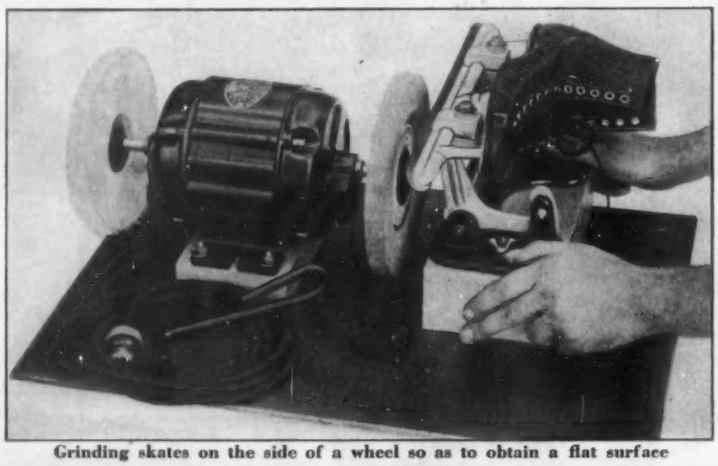
Flat-grinding Skates

SKATE manufacturers have long looked for a device which would make it possible to grind skates on the side of an abrasive wheel. With this kind of an outfit, the thin, tubular skate is ground flat instead of concave and the wide surface on the side of the wheel makes it easy for an operator to get a true straight-edge effect. The new machine illustrated consists of a one-quarter horsepower motor, mounted on a steel plate. The wheel is of the recess, or cup type. On the left of the motor is a cotton buff for polishing. The skate holder is made of malleable iron, is adjustable and is especially designed to hold tubular and other styles of skates. A block for raising the base of the skate holder to the proper height is furnished with the outfit.



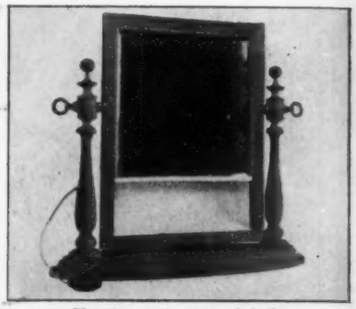
The checkers cannot slip

"Making up" with an air brush is a new way to save time



Grinding skates on the side of a wheel so as to obtain a flat surface

A terrestrial globe and reading lamp combined is instructive and novel



Shaving mirror and light

An Aid to "Exterior" Decoration

"MAKE-UP" is usually a comparatively easy matter, but if you are going under the studio lights as a Filipino, there is considerable territory to cover and time is money even in the movies. One director conceived the idea of "painting" the body with an air brush. The photograph shows Myrna Loy's maid applying the tint with this system.

Lighting the Face for Shaving

HOW often do you think you have a smooth shave and find that the contrary is the case? The principal cause of bad shaving, a dull razor excepted, is bad lighting. The device shown in the upper right-hand illustration consists of a shaving mirror which is provided with a light placed behind the mirror and partly surrounded with a dull white reflector designed to reflect the light outward and upward to the face. The one shown is intended more for a bedroom than for a bathroom.

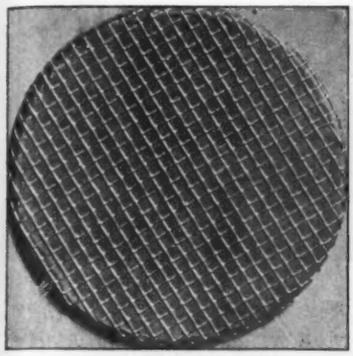
Lighting the "World"

A NEW combination globe and reading lamp is shown in the illustration in the center below. It shows how our earth looks when illuminated by the sun. It shows day and night as well as the seasons. The globe rotates from left to right so that the simulation of morning is at the left side of the illuminated part and that of evening is at the right.

Non-skid Checkers

THE good old game of checkers has been improved. Each checker is magnetized and will not move from its position on the metal board unless propelled by the hand. The playing surface is made from a thin piece of steel. When not in use, the checkers must be kept upon another piece of steel placed in the bottom of the box which holds them.

The secret is in the magnet

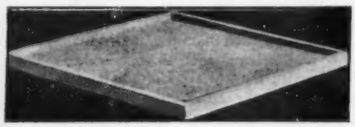


An acoustic wire cell

Resonant Walls Produced by Acoustic Tiles

MR. EMILE BERLINER—the inventor of the microphonic-transmitter and of a modern disk talking-machine with lateral-cut records—studied sound conditions in auditoriums for many years and finally concluded that the cause of bad acoustics was the hardness or rigidity of the usual brick or stone walls. It was found that where an auditorium had wooden walls, notably of pine or spruce, that vibrate freely, there were good acoustics.

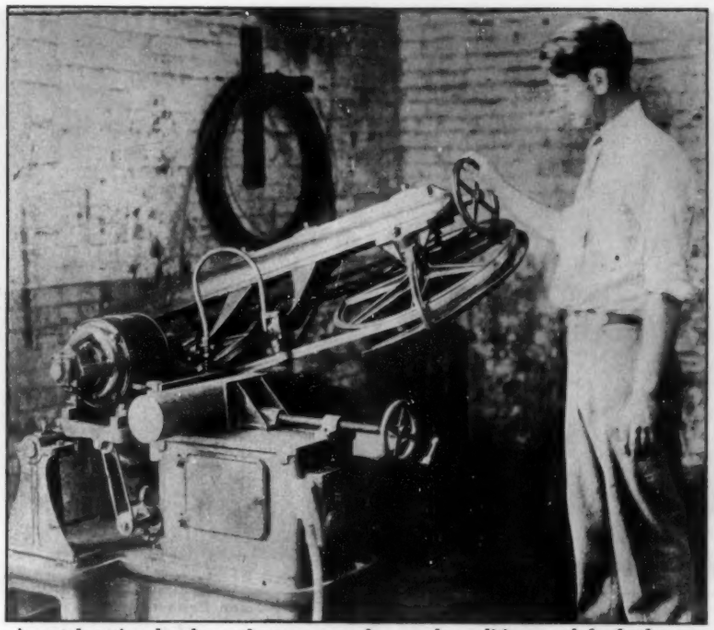
Mr. Berliner recently demonstrated the remarkable resonance of his acoustic tiles, which are made of porous cement, hard as stone, but which have the resonance of wood when affected by sound waves. Mr. Berliner's solution of hall acoustics consists of cementing these tiles to the walls of an auditorium in a sufficiently large area and thus combining the hardness and dignity of a stone wall with the resonance of wooden panels. The tiles can be molded ornamentally to suit the architect. They may form the final finish of the walls, or they may be painted without reducing their efficiency. Another method of obtaining good acoustic effects consists of attaching flat "cells" of wire netting to a rough finished wall and spreading what is known as "acoustic" cement over them.



Underside of an acoustic tile

A Boon to the Farmer

IT is easier to get a radio in a farmer's house than it is to put in sanitary appliances. A concern of Alliance, Ohio, has just introduced a combination table and tub which should solve many a problem in outlying districts. The new device is shown fully in the illustrations at the bottom of the page. There is little to add in the way of description, except to say that the contrivance is easily moved and set up, and when not used as a table, can be used as a wash-tub or bath-tub.



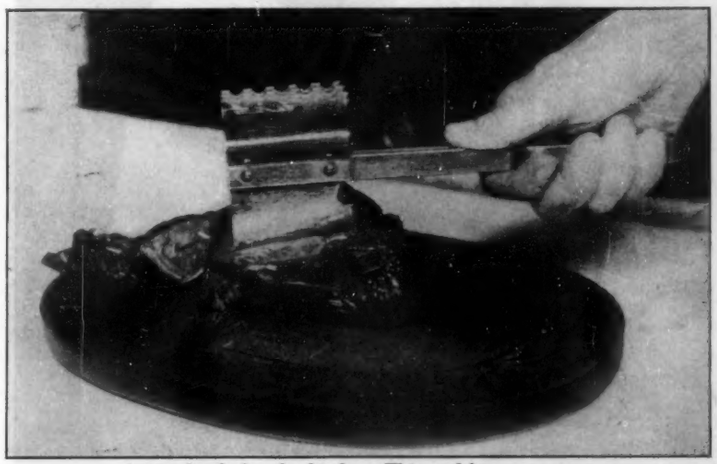
A metal-cutting band-saw that reverses the usual conditions and feeds the saw into the work

Band-saw for Metal

IN the saw which we illustrate at the upper center of this page, there is a cutting-head or arm which, by its own weight, feeds the saw into the work. This differs from the usual method of feeding the work into the saw. The weight of the horizontal cutting-head is counter-balanced by a powerful spring which gives an automatically variable feed-pressure to compensate for differences in the hardness of the metal being worked. This characteristic saves the band-saw blade and gives a straight cut regardless of the variations in the stock, whereas the positive feed of the vertical type of band-saw forced the stock into the saw, resulting in crooked cutting, teeth stripping and blade breaking.

A Kitchen Hatchet

A KITCHEN utensil which seems destined to perform many culinary operations is shown in the center of the page. Its descriptive literature states that "it is a very efficient tool for hotels, restaurants, boarding houses, et cetera." This leaves us guessing as to whether steak is going to be made tender or "hash" is to be chopped. There are three blades shown at the top, with teeth admirably adapted for scaling fish, or for use as a "meat pounder." Our illustration shows the axe in use as a cleaver. Food can be chopped with the same blade.



A tomahawk for the kitchen. This tool has many uses

A "perpetual motion" toy

A Curious Toy

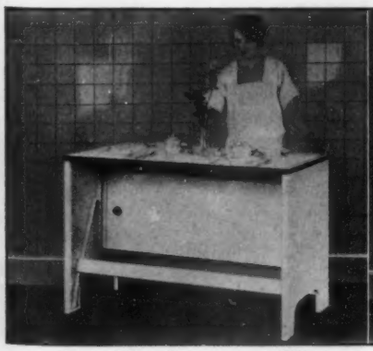
A SCIENTIFIC novelty which never fails to excite interest consists of a small, bronze dragon with a cloth-covered head. In its mouth there is a glass tube, about two inches long, closed at the end. In the tube is a drop of red liquid, but this drop, instead of standing still, moves upward into the dragon's mouth. Once the drop disappears in his mouth, another drop appears in the bottom of the tube, and this too is drawn up.

The explanation of the action is very simple. The dragon's head is a glass bulb connected to the sealed tube in which a volatile red liquid is enclosed. This bulb and tube contain nothing but the red liquid and its vapor. The cloth which covers the head is moist. Therefore, evaporation will occur, and this will lower the temperature of the bulb, thus condensing the vapor and reducing the vapor pressure. As the other end of the tube is exposed to the room temperature and it has no evaporation to cool it, the vapor pressure on that end of the drop will be higher. This difference in pressure between the two ends of the tube causes the drop of red liquid to move toward the area of lower pressure in the head of the dragon.

"No more "housemaid's knee"

Comfort for the Scrubber

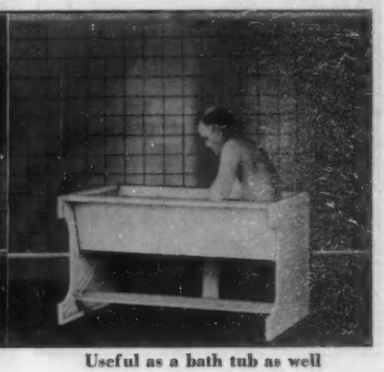
THOSE who scrub and clean can now have comfort as well as knees free from injuries. The "coaster" shown is mounted on ball-bearing castors and is provided with two padded sections for the knees. The user can move quickly from one place to another while kneeling upon it.



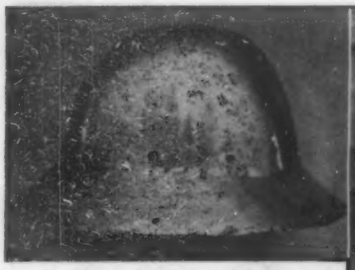
The table-tub is now a table

Getting the tub into action

It is a good clothes tub



Useful as a bath tub as well



Iron hat of the Middle Ages

Latest stages in the evolution of the iron helmet

A Medieval helmet

The Helmet-style of 1926

THE World War brought into use something we thought was obsolete—armor. Not only did we have "tin hats" for our soldiers, but towards the end of the war, we were producing a certain amount of body armor as well. The experiments which were carried on were of the greatest interest. Fortunately, we have a most painstaking account of all of them in "Helmets and Body Armor in Modern Warfare" by Dr. Bashford Dean, Curator of Armor in the Metropolitan Museum of Art. During the war, Dr. Dean was Major of Ordnance, U. S. A., in charge of the armor unit, Equipment Section, Engineering Division, Washington, D. C. Dr. Dean says:

"The Metropolitan Museum placed at the disposal of the War Department not only its collection of armor, but also its staff of armor specialists, and its armor repair-shop to aid in developing and making whatever models were needed.

"At an earlier time, a museum would have considered armor only as objects of artistic value. Nevertheless, in any phase of the study of armor, it becomes often difficult to distinguish between the esthetic and the practical. In olden times there is no question that the beauty of his armor helped the soldier to bear the burden. And in modern warfare, it is more than probable that no armor would have been accepted widely had it not possessed certain esthetic elements. The helmet, for example, worn by the French in the present war, would never have gained its extraordinary success had it not been attractive in its lines—designed, by the way, by no less a personage than Edouard Detaille, whose pictures of *beaux soldats* have for many years been familiar to all. Nor would the extremely simple British helmet have been accepted generally and promptly had it not an especial set and swing of its own."

Since the war, further experiments were carried on; a more advanced type of helmet shown at the left in the center illustration above has been evolved as being more effective than the ordinary type shown at the right. This photograph shows Brig. Gen. C. C. Williams, Chief of Ordnance, U. S. A., comparing the two styles. At the left and right will be seen *chapel de fer* or literally "iron hats" of the Middle Ages.

Dr. Dean summarizes the whole question of armor as follows:

"1. That the helmet has been adopted as regular military equipment of many nations.

"2. That helmets and body armor have been found, in broad averages, of distinct advantage to the wearers.

"3. That body armor, in spite of the protection which it affords, finds little favor with the soldier. For numerous reasons, he would rather take his chances of injury.

"4. That effort should be made, none the less, to demonstrate more clearly the protective value of body armor, to improve its material and design, and to reduce to a minimum the discomfort which will always be experienced by its wearer—in a word, to meet the objections to the use of armor, which have been brought up on the sides both of theory and of practice."

Ironing a garment trimmed with flexible beading

Flexible Beading for Women's Wear

THE young lady in the illustration in the center of the page is pressing a blouse trimmed with flexible beading. Information from England calls the trimming "flexible glass beading" but we hesitate to use the word "glass" as we doubt if the beads are of glass at all. The composition is called "Juwella." This mysterious material seems to have remarkable properties of lightness and the ability to be washed and ironed without injury.

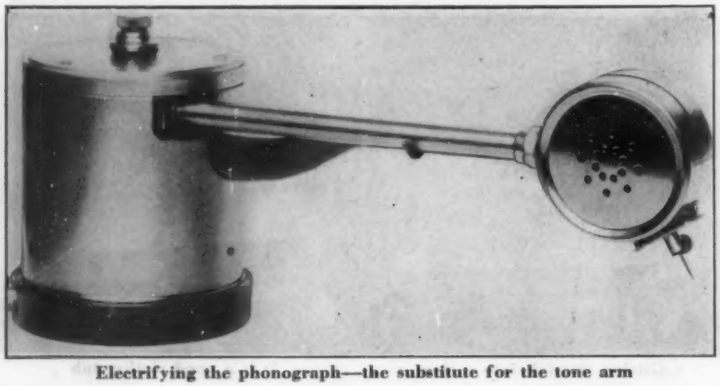
An Efficient Opener for Preserve Jars

WE all know how hard it is to open a jar of preserves when the cover sticks. The device shown eliminates all difficulty. The triangle has two feet which force their way under the glass top when the handle of the pointed screw is turned, thus loosening the cover.

A Device for Rejuvenating the Phonograph

A DEVICE manufactured by a Waterbury, Connecticut, concern makes it possible to electrify the old type of phonograph. It is said that the attachment makes the tone richer and smoother, and of far greater volume than it ever had before. This improved result can be obtained from any phonograph which has an even-running motor and a correctly balanced turn-table —regardless of the price paid for it. It will greatly improve the performance of the old style record, the manufacturer says, but when used to play the new-process, electrically-produced records, it will bring out all the tonal depth, clarity and range which is possible with the new-model phonographs. When this instrument is to be used, it displaces the regular tone-arm and horn, and utilizes a radio loudspeaker, either horn or cone type. It can be operated through the medium of a radio power-speaker; with any good radio amplifier and speaker; or with speaker only. In the first two instances, a one and one-half-volt battery is required, but with a speaker only, an ordinary six-volt storage battery is used. It is said that the reproduction compares very favorably with a small orchestra, in volume and quality, but, having a sensitive volume adjustment, it can be regulated down to the soft effects needed in the home.

The cover is easily removed



Electrifying the phonograph—the substitute for the tone arm

Using the electric sound-box

A "mouse-trap" garage

A Portable Garage

WE recently secured from England two photographs of a "mouse-trap" garage which can be built by anyone handy with tools. The tiny building consists of a floor or runway on which the wheels of the automobile rest, as shown in both of our illustrations at the top of the page, and a cover hinged at the rear. This cover is like a great packing-case with the bottom removed. This is easily lifted when it is necessary to get at the machine. A system of bolts can also be applied so that the automobile can be locked up safely. The garage was designed by Mr. E. C. Gorden, England, the famous Brooklands racing motorist.

Laboratory Storms and Sunshine

THE weathering machine shown in the center of this page is an interesting laboratory device. Painted panels are placed upon the slowly turning wheel of the "weather machine" and subjected to the same conditions that paint must meet in actual outdoor use. The wheel is about three feet in diameter and has a rim about eight inches wide, to which the panels are attached. It makes one revolution in 45 minutes. The panels pass through a spray of water and then under a mercury-vapor arc lamp—the light from which is very strong in ultra-violet rays. They then pass in front of a bank of electric-light bulbs, which warm them considerably, and then dip immediately into a tank of very cold water. In this cycle are obtained all the factors which tend to break down paint films, namely, ultra-violet light, moisture and sharp temperature changes.

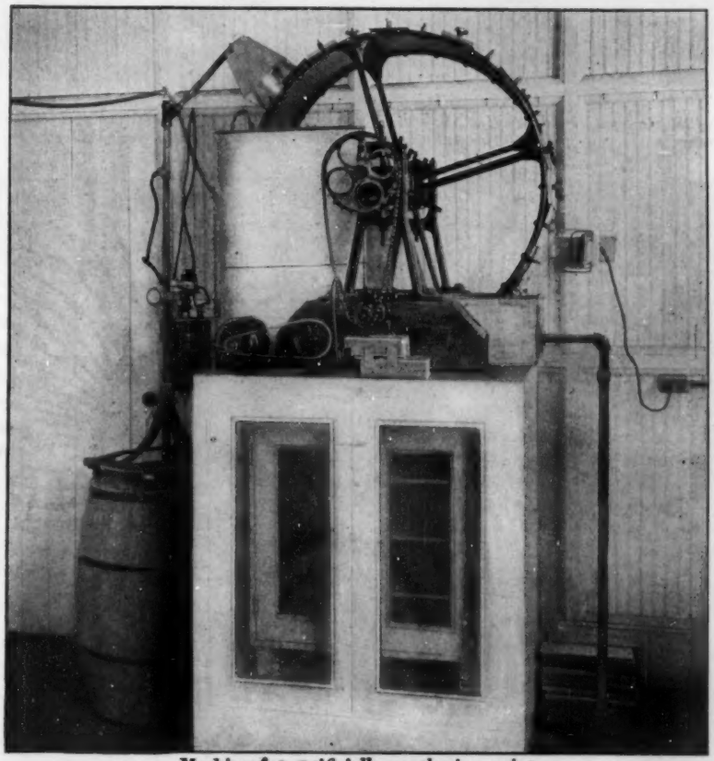
A Cane Seat

OUR English cousins are very fond of going to athletic meetings and other gatherings where seats are not provided in any great numbers, so, if they would sit down, they must take seats with them.

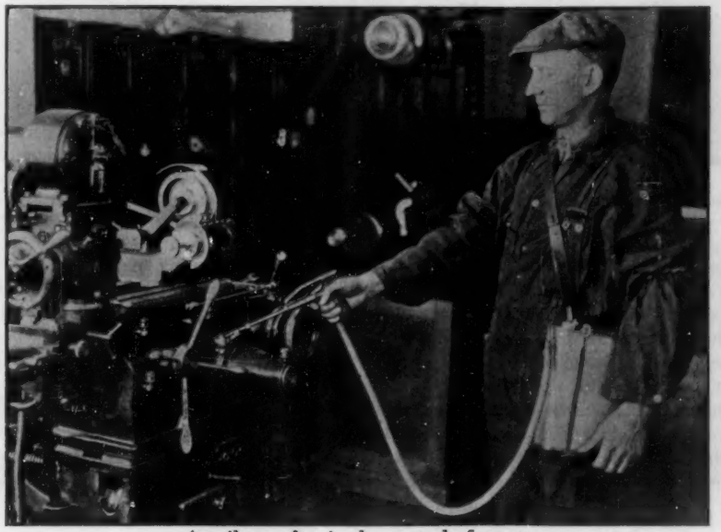
This cane is also a seat

Ewing Galloway

An overhead trolley crane for subway work



Machine for artificially weathering paint



An oil gun that is always ready for use

A child lifts the cover

They use portable affairs of all kinds. One of the latest is a cane; the crook handle opens out to make the seat. A metal plate serves to give a purchase on the ground. The illustrations at the bottom of the page show the device very clearly.

New Subway-building Machinery

THE work on a new subway which is being built in New York has resulted in some new engineering methods. The streets, with some few exceptions, are not completely closed to traffic, although they are necessarily very much torn up. On one section of the work, the contractor has introduced big, overhead trolley cranes as shown in the picture at the top center of this page. Three of these cranes have been built.

The trolley crane is 190 feet long and is located parallel to the curb. The main trusses have a clearance of 14 feet above the street level. Four columns at each end support the overhead structure. These columns rest on a four-wheel truck. There is a 25-foot overhang at either end. There are two buckets on the crane, each carried on a separate hoist. The crane-hoist elements of the rig are operated by two 40-horsepower motors and the traveling machinery is run by a 20-horsepower motor. The object of these cranes is to expedite work in busy streets both before and after the excavation has been decked over with planking to carry the street traffic.

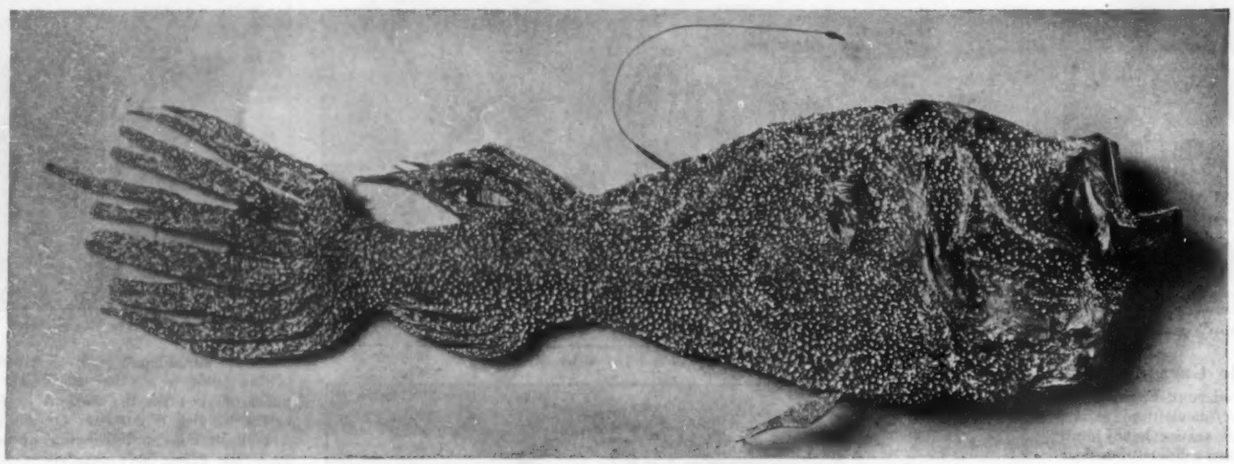
Oiling by Gun

WITH the device shown in the center photograph at the bottom of this page, special oil-cups are fed with oil through a "gun" supplied from a gallon reservoir. The engagement of a fork raises the cover of the cup and positions the spout for filling. A slight forward movement of the "forkgun," as it is called, against the cup causes the barrel to retract into the body of the gun, forcing a cupful through the spout.

The portable seat in use

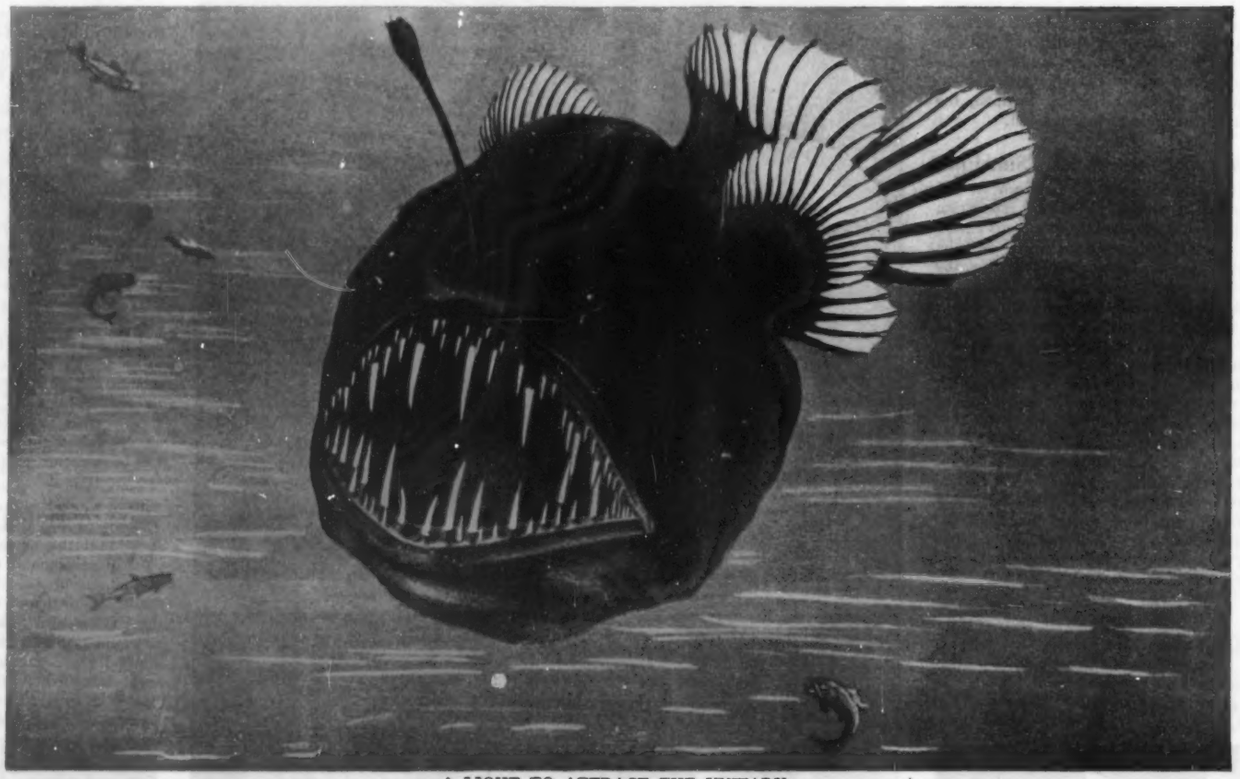
Deep-sea Fish Angle for Their Own Kind

Photographs from "The Illustrated London News"



WITH A "ROD AND LINE" ON ITS BACK

The angler fish, Ceratias holbolli, *is one of the most peculiar denizens of the sea. It carries a "rod and line" on its back. This female is nearly forty inches long. The comparatively tiny male fish is permanently attached below, a peculiar case of biological parasitism*



A LIGHT TO ATTRACT THE UNWARY

In the deep sea fish, known as Melanocetus prechi, *there is a luminous bulb on the tip of the "rod." This is used to lure prey in the darkness of the depths. Like the crocodile in "Alice in Wonderland," the open mouth is ready to "welcome little fishes with gently smiling jaws"*

In the fish shown in the upper illustration, a ray of the dorsal fin is prolonged into the form of a line, with a swelling at the end which acts as bait. The male and the female of this strange fish truly become of one flesh. The four-inch male becomes attached to the four-foot female while very immature. Professor Pycraft of the British Museum of Natural History, a well-known writer on zoology, says: "The diminutive male, it would seem, develops from the lower jaw, a number of filamentous outgrowths, at first, probably, adhesive and hence affording the initial grip on his mate. But, be this as it may, the stimulus of this contact speedily brings about in the tissues of the female the formation of a number of vascular papillae, which, penetrating the skin of the male, form a plexus of blood-vessels; thus supplementing, if not entirely supplanting, the need for taking food in the ordinary way. The male, in short, is nourished much as in the case of the embryos of the higher vertebrates; that is to say, by what is, to all intents and purposes, a 'placenta'—the plexus of blood-vessels which enables the growing embryo to derive nourishment from the maternal tissues. The insignificant male, thus relieved from the necessity of moving from place to place in search of food, or even of eating at all, has become a mere degenerate. His only mission in life is to provide the milt necessary to fertilize the eggs. He has become reduced, in short, to the condition of a parasite, albeit a 'beneficent parasite,' since his suppression would lead to the extinction of the race."

The Scientific American Digest

A Review of the Newest Developments in Science, Industry and Engineering

Conducted by Albert G. Ingalls

Ashore and Afloat

Two craft that have a remarkable superficial resemblance, one primarily for land travel and the other for travel by water, are shown in illustrations in these columns. Both are propelled by airplane-type propellers.

The first was invented by Mr. George McLaughlin of Bangor, Maine, and is equipped with a 70-horsepower engine which, it is claimed, will drive it at the rate of 60 miles per hour. On either side it has airtight pontoons attached to the running boards. Both on land and water it is steered by the front wheels, there being no rudder.

The sea-glider shown is said to make better than 50 miles per hour. It is built in Gulfport, Mississippi. The bottom is ribbed with six-inch, V-shaped strakes running fore and aft. These provide recesses every six or eight inches, for the purpose of collecting air between the bottom of the boat and the water. In running, the boat rises well out of the water and to this, in part, is due its speed.

The boat is 20 feet in length, has a beam of six feet and is four and one-half feet high. A Curtiss 90-horsepower motor furnishes the power to drive an ordinary airplane propeller. The cabin is three feet wide, eight feet long and has seating capacity for eight passengers. When docked, the craft draws four and one-half inches of water, but when running the draft is reduced to about one inch.

* * *

New Light on the Cosmic Ray

THAT the penetrating rays from space, first observed by a German scientist, Dr. Werner Kolhoerster, and recently studied by Dr. R. A. Millikan, of the Norman Bridge Laboratory, Pasadena, California, undergo a daily variation is shown by experiments recently completed by Dr. Kolhoerster in Switzerland. These studies, which were conducted on the Jungfrau glacier, and in other mountainous regions, were made with the assistance of Dr. Gubert von Salis.

As a result of Dr. Millikan's observations, it was supposed that these rays, which are very short vibrations, similar to ordinary light and X rays but far shorter than either, came in equal quantities from all regions of space, so that their intensity was the same at night as by day. But the new experiments show that they vary, not with the position of the sun, but with the aspect of the heavens. When the Milky Way is most nearly overhead, the intensity of the rays comes to a maximum. When the constellations of Hercules and Andromeda are best placed, the intensity is greater than at other times. This shows, in the opinion of the experimenters, that although the rays come from all parts of space, the chief centers of the rays that reach the earth are the Milky Way and the constellations of Andromeda and Hercules.

The center of radiation in the constellation of Andromeda seems to be the great spiral nebula, which Dr. Edwin Hubble, astronomer at the Mt. Wilson Observatory in California, has shown to be a system of stars similar to that which makes up the Milky Way, and all the stars that we can see, including the sun, and which astronomers call the galaxy. It would therefore seem that Dr. Kolhoerster's and Dr. von Salis's experiments have also provided a new proof of the similarity of these spiral nebulae to our galaxy.—*Science Service.*

The sea-glider is driven by an airplane engine, but is for use on the water only

* * *

Airplane Prospecting for Ores

THE romantic day of the old "sourdough" prospector is rapidly passing. Scientifically-trained geologists are going into the field for large mining companies. And now, says a writer in *Engineering and Mining Journal* (New York), airplanes are to be employed over a vast area in Africa to prospect for copper ore.

While the country in the region to be searched—the new Katanga copper belt of the southern Belgian Congo and northern Rhodesia—is wooded as a whole, all of the many great outcrops of copper ore thus far found there by ordinary methods are almost wholly bare of vegetation. Therefore, the flying prospector will simply look for unwooded areas. The bareness of the copper areas is due to the presence of the salts of copper which kill the trees and other vegetation. In addition, in this particular locality, the structure of the rock formations causes the ore outcrops to lie in characteristic wide curves. This further narrows the search for copper.

Working on foot the ordinary prospector was so close to the earth's surface that he cannot obtain a general view of it. To state a paradox, he "could not see the woods for the trees." Such areas as those just described do not usually stand out in diagrammatic form to him. He needs a view of the earth's surface from a distance. The airplane provides such a "birds-eye" view.

"Cases can be cited," it is said, "where there are two, three or more ore outcroppings in the same general locality that until recently were supposed to be as many different deposits; but familiarity with the district has brought to light a curved opening through the woods, from fifty to several hundred feet wide, connecting the croppings and proving them to be a single large deposit." Similarly, many other outcroppings should become visible from far aloft.

It has been found that an engineer and a practical prospector, assisted by a few natives, can prospect about 200 square miles in a year by the ordinary method. But an airplane can work about 1,300 times as fast as this.

In actual work, the African area, which contains 130,000 square miles, is not merely to be scanned by the eye of the flying prospector. Instead, photographs of areas of about 1,000 square miles are to be taken by the continuous film method that is usually employed in airplane mapping. Wherever these preliminary photographs provide suspicion of the existence of ore bodies, the spot will be revisited and photographed more carefully. The geologist also will fly over it, studying it from the air. The next stage of advance will be land visits to these areas, and if conditions then warrant, the pegging out of the claim and systematic prospecting by the usual system of cross-trenching and core drilling.

It is not unlikely that the principle of this method, or some similar principle determined by local conditions, could be employed in other places. For example, airplanes have largely supplanted the oldtime searcher for timber. This gentleman was often "personally conducted" on a devious route purposely chosen by the salesman, to take him through only the best timbered parts of a tract and thus to mislead him concerning its value. Airplanes are also being used for certain archeological investigations; it having been found, for example, that in England the lost outlines of prehistoric earthwork defenses show plainly on the darker background of cultivated areas, while they could never have been recognized by those who stood only a few feet above the surface.

* * *

Even an Editor Can Make a Telescope!

IN cases when the amateur telescope maker lacks access to machine tools and has no equipped workshop, the type of telescope shown in these columns is perhaps the most suitable to construct. It was made from instructions published in the Scientific American book, "Amateur Telescope Making."

The mirror is six inches in diameter and has a focal length of 48 inches. The wooden upright was sawed out from a two-inch pine plank. The block which forms the polar axis is about three inches in thickness. Close observation of the picture will reveal

The 70-horsepower engine drives this amphibious "vehicle-craft" both while on wheels ashore, and when on the pontoons in the water

Forward end of the "amphimotor," a propeller-driven motor car provided with pontoons which enable the car to travel in the water

that the mirror does not appear to fit the circular recess in the wooden shelf which supports it. In this shelf three concentric recesses, each a quarter inch deeper than the next larger recess, were first turned, thus making provision for the later insertion of seven-inch and eight-inch mirrors, respectively.

Since the focal length is fixed at 48 inches, the depth of the curves will necessarily be increased as larger mirrors are made. The seven-inch mirror has a focal ratio of approximately *f*.7, and the eight-inch mirror will require one of *f*.6 (focal length divided by diameter of aperture equals focal ratio, *f*). The same prism will serve for all three mirrors.

As it is not always practicable in the making to bring a mirror out at the desired focal length, provision was made for a few inches of deviation by allowing the wooden upright to project below the mirror shelf. However, it has proved possible by a little planning during the grinding operations to bring the seven-inch mirror within one-quarter inch of the desired focal length, and the remaining discrepancy will easily be taken up by the adapter at the eyepiece end. This consists of an extra tube of metal into which the eyepiece is inserted, and which, in turn, is inserted in the tube that carries the prism. This is also a convenience in observing, permitting the use of eyepieces of several different focal lengths. A brass collar or flange was shrunk on the prism-carrying tube, for the purpose of attaching it rigidly, and was screwed to the upright.

The wooden telescope and the youngest lady astronomer

Below the wooden mirror shelf, which is rigidly attached to the upright by means of brass angle-plates obtained at a hardware store, there is a small wooden box containing an ordinary dry cell. A duplex cord leads up the edge of the upright to a little electric lamp taken from a flashlight. This may be lighted simply by turning the bulb in its socket. The light serves to illuminate the star chart held on the observer's knee, yet, being let in flush in a hole bored in the upright, it does not shine in his eyes. It should be as weak as will just enable him to make out the chart, thus favoring the sensitivity of the eye during observation.

In order to line up the polar axis with the pole of the heavens, three holes were drilled in the 2-inch pipe that serves as a pillar. These were tapped out and setscrews were inserted. The lower end of the bent polar axis was stepped into a recess in a wooden block which was driven to the bottom of the pipe. When the rather difficult job of aligning the polar axis was finished, the space between the pipe walls and the axis shafting was concreted and the setscrews were later withdrawn.

Powers of 48, 96 and 192 diameters (approximate) are provided for by the use of one-inch, one-half-inch and one-quarter-inch eyepieces, respectively. Near New York, with its haze and glare and smoke, the one-inch eyepiece is the most satisfactory, but 96 diameters could often be used in rural districts in the east, while 192 diameters would prove feasible in such places as the west where the atmosphere actually consists of air.

* * *

Earthquakes and Earth Rotation

IN the "Transactions of the Astronomical Observatory of Yale University," Volume 3, Part VI, Dr. E. W. Brown has set forth his investigation of the constancy of the earth's rate of rotation, says R. M. Wilson of the United States Geological Survey. This is especially interesting from the point of view of seismology and volcanology in that the cause of these changes in rate of rotation is ascribed to geophysical changes within the earth itself. To change the rotational momentum of the earth, some gain or loss of either its mass or its impounded kinetic energy of rotation must take place. Its rotational kinetic energy is drained slightly by tidal friction. This effect is well understood and has been corrected for in the investigation. But apparently there still remain unexplained changes in the rate of rotation, in addition to the retardation explainable by tidal friction. Rate of rotation, mass and distribution of mass (moment of inertia) are factors making up rotational momentum. It is therefore possible to alter the rate of rotation, and yet retain rotational momentum and mass unchanged, by altering the distribution of the mass. Thus, if the earth expands, its mass is distributed on the whole somewhat farther from the axis of rotation, its moment of inertia is greater, and therefore its rate of rotation may be slower, without loss or gain of mass or energy. An example of this effect may be had by swinging a weight on a string in a complete circle, allowing the string to wind up on the finger—the shortening of the radius will speed up rotation without the input of any more energy.

Dr. Brown suggests periodic expansion and contraction of the earth, in amount between five inches and twelve feet change of mean radius, as an explanation of the apparent fluctuations in rate of the earth's rotation. These fluctuations in rate are detected astronomically in the discrepancies developed between the computed and observed places of the moon and sun. That is, using time as derived from orbital motions and the gravitational theory the earth appears to run ahead or behind its mean rate of rotation by a slight amount, so that in the course of years a few seconds may be gained, then lost, and gained again.

If this is to be explained by the shrinking and expanding of the earth, one might expect to find evidences of it here beneath our feet. Dr. Brown reasons that this amount of change would by no means be enough, in itself, to stretch or shrink the crust of the earth to the point of fracture. But these periodic strains in the crust of the earth may be enough to liberate or shake loose greater strains accumulated almost to the breaking point through other causes—isostatic compensation for example. The investigation shows, in fact, that there is apparently a rough correlation between frequency of earthquakes and change of rate of rotation. Astronomy has, therefore, brought a direct challenge into the realm of geophysics.—*Extract from "The Volcano Letter," published by the Hawaiian Volcano Research Association, Volcano House P. O., Hawaii.*

* * *

Searchlamp Reduces Auto Thefts By Half

A 30-INCH, 43,000,000-candlepower searchlamp has cut the theft rate of motor cars in half in the city of Worcester, Massachusetts, where the powerful light is used.

Instructed to be on the lookout for flashes from the light from its position on a building, the police upon seeing it go at once to the nearest patrol box for details of the theft. The light is then turned on the section of the city where the theft was committed.—*Science Service.*

* * *

Maximum Range of Guns in United States and British Navies

THE present agitation in favor of increasing the range of the guns on the older battleships of our Navy is not the first time this subject has been brought before Congress. The matter was thoroughly discussed in 1925. At that time, the Navy submitted the tables herewith, giving the maximum elevation and the maximum range of every ship in the two navies. It reveals the startling fact that although our older ships are outranged from 800 to 2,800 yards by the older ships of the British, our most modern ships outrange the most modern ships of the British by from 10,200 to 11,400 yards. This means that in approaching our fleet, the British ships would be exposed to our gun fire for half an hour before their guns could reach our ships.

* * *

Fused Quartz, a Remarkable Material

THAT the peculiar property of the new and remarkable material, clear fused quartz, of failing to expand greatly when heated, opens new scientific advances in fields as distinct from each other as astronomy and fire-prevention, was the statement made to the New York Electrical Society by Dr. E. R. Berry, Consulting Engineer of the Lynn, Massachusetts, works of the General Electric Company. The clear, fused quartz which Dr. Berry has produced is not only very resistent to the action of heat, but is also the most transparent substance known, transmitting with the same perfection not only the rays of ordinary light, but also the rays of invisible ultra-violet light and infra-red light (the so-called "black light").

Clear, fused quartz is manufactured in an

CAPITAL SHIPS OF THE UNITED STATES

Name of Ship	Turret Guns: Diameter of Bore in Inches	Turret Guns: Length in Calibers	Maximum Angle of Elevation in Degrees	Range in Yards	Speed in Knots	Displacement in Tons
West Virginia	16	45	30	34,500	21.2	32,600
Colorado	16	45	30	34,500	21.4	32,600
Maryland	16	45	30	34,500	21.1	32,600
California	14	50	30	35,500	21.7	32,300
Tennessee	14	50	30	35,700	21.4	32,300
Idaho	14	50	15	24,000	21.3	32,000
New Mexico	14	50	15	24,000	21.1	32,000
Mississippi	14	50	15	24,000	21.1	32,000
Arkansas	12	50	15	24,350	21.1	26,000
Wyoming	12	50	15	23,500	21.2	26,000
Arizona	14	45	15	21,000	21.0	31,400
Pennsylvania	14	45	15	21,000	21.1	31,400
Oklahoma	14	45	15	21,000	20.6	27,500
Nevada	14	45	15	21,000	20.5	27,500
New York	14	45	15	21,000	21.5	27,000
Texas	14	45	15	21,000	21.0	27,000
Florida	12	45	15	22,000	22.1	21,825
Utah	12	45	15	21,600	21.0	21,825
Grand Total						525,850

CAPITAL SHIPS OF THE BRITISH NAVY

Name of Ship	Turret Guns: Diameter of Bore in Inches	Turret Guns: Length in Calibers	Maximum Angle of Elevation in Degrees	Range in Yards	Speed in Knots	Displacement in Tons
Royal Sovereign	15	42	20	24,300	21.6	25,750
Royal Oak	15	42	20	24,300	21.5	25,750
Revenge	15	42	20	24,300	21.9	25,750
Resolution	15	42	20	24,300	21.6	25,750
Ramilies	15	42	20	24,300	21.5	25,750
Malaya	15	42	20	24,300	25.0	27,500
Valiant	15	42	20	24,300	25.0	27,500
Barham	15	42	20	24,300	25.0	27,500
Queen Elizabeth	15	42	20	24,300	25.0	27,500
Warspite	15	42	20	24,300	25.0	27,500
Hood	15	42	30	30,300	31.5	41,200
Renown	15	42	20	24,300	31.5	26,500
Repulse	15	42	20	24,300	31.0	26,500
Tiger	13.5	45	20	23,800	29.0	28,500
Benbow	13.5	45	20	23,800	21.5	25,000
Emperor of India	13.5	45	20	23,800	21.5	25,000
Iron Duke	13.5	45	20	23,800	21.6	25,000
Marlborough	13.5	45	20	23,800	21.6	25,000
Thunderer	13.5	45	20	23,800	21.	*22,500
King George	13.5	45	20	23,800	21.4	*23,000
Ajax	13.5	45	20	23,800	21.1	*23,000
Centurion	13.5	45	20	23,800	21.9	*23,000
Grand Total						580,450

*These four to be scrapped when Nelson and Rodney are completed, when total will be 558,950, against United States 525,850; the extra tonnage allowed to offset greater age of British Fleet.

electric furnace by heating, at very high temperatures, a mass of tiny, natural crystals, familiar as rock crystal. Not only is enormous temperature necessary, but, in order to prevent the occurrence of bubbles in the finished article, Dr. Berry and his associates are compelled to heat and cool the mass of rock crystals under the alternate application of a vacuum and of gas pressures reaching, in some instances, a pressure of several thousand pounds to the square inch, a pressure which no ordinary steam-boiler would withstand for an instant.

The applications of this new material to the science of astronomy resulted from its value for the preparation of great blocks now made of glass on which are ground the exact mirror surfaces used in great telescopes like those of the famous Mt. Wilson Observatory in California. To prepare glass blocks for the receipt of the delicately ground surfaces of these mirrors, is a task of years. Not only must the glass block itself, eight or ten feet in diameter, be cast and annealed with the most infinite care, but the grinding of the mirror surface is even more laborious. When the grinding approaches its final perfection, workmen are able to work on the glass only for a few minutes each day.

This enormous difficulty is avoided with blocks of fused quartz, because the heat due to the grinding does not cause the quartz to expend or to become distorted. Dr. Berry demonstrated this property of the material by means of a spectacular experiment. A tube of glass, heated in a gas flame and plunged into water, burst instantly into pieces, due to its own temperature change. The tube of quartz, heated to a temperature at which glass boils like water, not only withstood this temperature itself, but survived, undamaged, a plunge into a basin of ice-water.

Recent discussion among astronomers has emphasized the desirability of constructing many large telescopes, to be placed in different parts of the earth so that no portion of the sky will ever be without its observer watching for celestial events. To construct a score or more of telescopes desirable for such a continual watch on heavenly happenings, would require, if glass mirrors or lenses are to be used, the expenditure of money far beyond the resources of present-day astronomy. On the other hand, Dr. Berry predicted that if clear fused quartz is used for this purpose, it would be possible to construct a series of such large telescope mirrors much more quickly and easily than would be possible if glass is to be used. It is to be hoped that some philanthropist interested in astronomy may soon take the lead in some development of this kind.

Fused quartz tuning-forks suffer virtually no alteration in tone due to temperature changes

The remarkable property possessed by clear fused quartz of withstanding enormous temperature change without important alteration in size or shape has enabled its use, Dr. Berry explained, in a novel little instrument recently developed for releasing the water from automatic sprinkler systems with more definiteness and less chance of accidental opening than is possible with existing devices. A small hollow capsule of the clear fused quartz is filled with a liquid which expands rapidly on rise of temperature. The quartz capsule does not expand. Accordingly, when the temperature increases suddenly, the liquid inside the quartz capsule swells and bursts its containing shell, thus releasing the mechanism of the sprinkler. These liquid-filled quartz capsules may be arranged to open a sprinkler system at a much lower danger temperature than is possible with any existing device.

The property of clear, fused quartz of transmitting ultra-violet rays will be of great importance, Dr. Berry discloses, in the newer studies now in progress on the effect of these remarkable invisible rays on light and health.

Dr. Alfred F. Hess, Professor of Clinical Pediatrics, Bellevue Medical College, and a recognized leader in the investigation of the medical and biological properties of ultra-violet rays, also addressed the New York Electrical Society, describing recent scientific investigations on the influence of ultra-violet rays on health. Dr. Hess has discovered not only that ultra-violet rays have remarkable curative powers on such diseases as rickets, but also that certain food materials, when exposed to ultra-violet rays for a time themselves acquire the same curative value. This is the scientific basis underlying the recent British announcements of what are called "sunlight pills."

The clear, fused quartz described by Dr. Berry is the essential material in the developments of modern devices for the production and use of ultra-violet rays for purposes of medical treatment. Clear, fused quartz is the only material known which is fully transparent to the ultra-violet rays and which is capable, at the same time, of being used for strong tubes, lenses, plates, and the like.

* * *

Chemists Work on Ideal Fuel From Coal

THE scientific world is at work on a new fuel from coal which will be smokeless and almost wasteless, for it is expected to save a large portion of the three-fourths ton of coal that now goes up the chimney for every ton burned in the ordinary way. At the recent meeting of the American Chemical Society chemists from all over the United States discussed the pros and cons of "semi-coke," the proposed new fuel.

The difficulties in the way are more economic than scientific. "Semi-coke" is to be made by a low temperature process which requires entirely different apparatus from that used in making ordinary coke in by-product ovens. The by-products of semi-coke are different from those of common coke and their economic value has not been established. In fact, it presents an entirely new group of materials for chemists to learn how to utilize.

In the old coke-making process, the four primary products recovered, gas, tar, ammonia and light oils, are raw materials in the manufacture of explosives, fertilizers, dyes, and chemicals used in American factories. The coke is used mainly in the making of steel. A small amount is used for domestic fuels, especially during war emergencies and coal strikes, but the housewife thinks it is a poor product to burn in the kitchen range.

The new semi-coke, because it is heated at a low temperature, retains many of the higher oils and other combustible substances. It is smokeless and is said to burn as easily as coal and much more readily than finished coke. The gases, oils and ammonia that are lost in smoke when coal is burned are recovered. Semi-coke is therefore hailed by many scientists as the solution for a world problem.

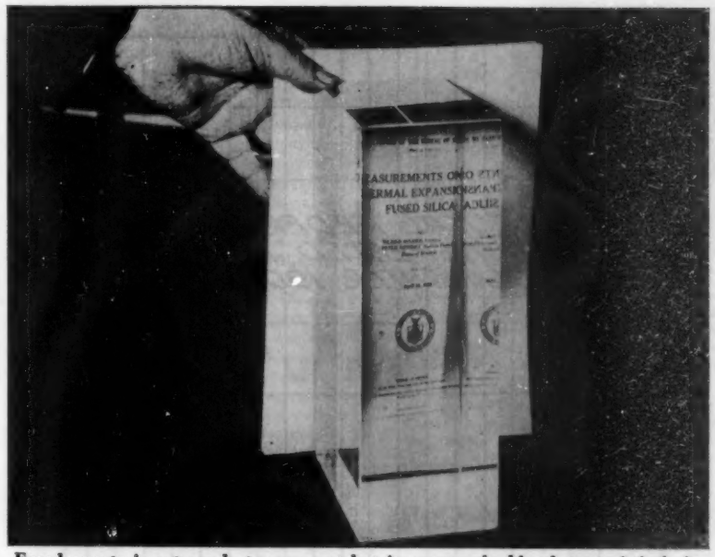
With the world coal supply going down and the cost of production, labor and transportation going up, every coal-using country is trying to use coal less and get more out of it. Great Britain hopes to get fuel oil for her navy from the part of the domestically burned coal that is now wasted. In England as in the United States it is a question of what to do with the by-products of semi-coke, and how they can be made to pay. The new method yields more tar, but it is thin and oily and unlike the well-known coal tar. The yields of gas and ammonia are less, but the gas is much richer and higher in fuel value, which is a compensation.

"Making semi-coke by low-temperature carbonization of coal retains all its initial interest," said Prof. S. W. Parr of the University of Illinois, "in spite of the preponderating element of adverse circumstances from the industrial viewpoint, such as costs of installation, operating expense and the undetermined value of the by-products, especially tar and ammonia."

The properties of these new by-products are already being studied by chemists. Sumner R. Church of New York City who has studied the by-products of low temperature carbonization of Illinois coal found that satisfactory oils and pitches were obtained by refining the new tar in the old way.

"The new tars possess to a surprising degree the characteristics of the most desirable types of high-temperature tar," Mr. Church said. "An important feature of the new tars is their high content of tar acids, falling between phenol and cresols in boiling range."

The amount of heat necessary to carbonize various types of coal at the comparatively low temperature of 1,100 degrees, Fahrepheit, has been measured by Stephen P. Burke and V. F. Parry of Long Island City. They found that Pittsburgh coal required only seven British thermal units of heat energy, while Utah non-coking coal took 37 and Denver sub-bituminous coal 81 units.—*Science Service.*



Fused quartz is extremely transparent but its most valuable characteristic is its low coefficient of expansion—only about one-twentieth that of glass

* * *

X-Raying Seeds Improves Crop Yield

X-RAY treatment of seeds, hitherto regarded as invariably harmful in its effects, is now declared beneficial by Dr. M. Jacobson, a plant physiologist of Camden, New Jersey, who claims that he has obtained greatly increased yields from seeds subjected to mild doses of "soft" X rays. The difficulty with the earlier experiments, he states, has been that the rays were used in the harmful "hard," that is, shorter, wavelengths, or that the exposure was continued too long.

In one series of experiments which he reports, potted plants grown from rayed seeds grew faster and more vigorously than those grown from unrayed seeds, they flowered and fruited from one to three weeks earlier, and their yield was from 15 to 170 percent greater, the fruits being always more numerous and often larger individually.

Seeds were not the only things that benefited by X-ray treatment, Dr. Jacobson says. Potatoes raised from treated tubers gave, in three separate field tests, increases in crops of 35, 107 and 170 percent, over plantings of untreated tubers. Further tests showed that light has an unfavorable effect on X-rayed tubers and bulbs, which the experimenter states should be protected from the sun after raying, if large increases in yield are to be obtained. Time, however, seems to have little effect in diminishing the effect of the raying, for seeds and potato tubers kept for as much as three months after treatment yielded almost as well as did those planted immediately after exposure to the rays.—*Science Service.*

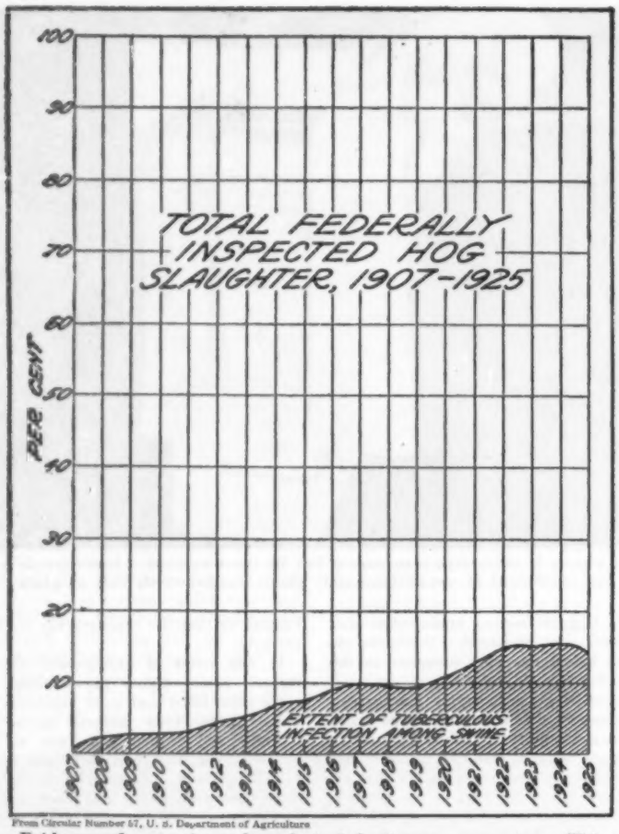
* * *

Tattooed Hogs

How hogs are now being tattooed—not for identification while alive, but for identifying the carcasses of diseased hogs after slaughter—is told by F. E. Murray, Associate Veterinarian of the United States Bureau of Animal Industry, in a small, five-cent bulletin recently issued by the Government Printing Office at Washington. A home-made device with which the hog is struck for the purpose of introducing pigment in a prepared design under the skin is all that is required to do the work.

Current developments in the eradication of tuberculosis from livestock point out the susceptibility of swine to the forms of disease affecting cattle and fowls, says the bulletin. In recent years a considerable proportion of the hogs slaughtered under Federal supervision fail to pass inspection. (See graph reproduced in these columns.) Tuberculosis is the principal cause for condemnations, with hog cholera and numerous other diseases contributing to the large total.

Extensive field investigations reveal that hogs contract tuberculosis largely from feeding behind tubercular cattle, drinking infected skim milk, feeding on diseased carcasses (including those of tubercular fowls) and the use of infected garbage as feed. In dealing with hog cholera and other diseases that spread rapidly, much of the success of control work depends on promptness in finding the centers of infection. The tattoo method of marking hogs for immediate slaughter is especially well adapted for establishing the origin of different lots.



From Circular Number 57, U. S. Department of Agriculture

Evidence of extensive tuberculosis infection among swine. This chart shows the percent of animals "retained" on account of tuberculosis, where Federal meat inspection is maintained. The extent of the disease finally determines whether carcasses are condemned wholly or in part. The tattoo method would reduce this infection

The reader will ask, "How is the tattooing done?" That is the simplest part. Ordinary "medium-heavy" phonograph needles are set in babbit-metal blocks, according to the required pattern. These are attached to a long, iron handle, ordinary black automobile enamel is brushed on the needles and Mr. Hog and all the other hogs are whacked on the back with this device. Strange to say, although it leaves the pigment deeply set beneath the skin, where no amount of scouring will remove it, and where it will later be found in the dead carcasses, the hogs seldom resent it by even a squeal—so thick are their hides.

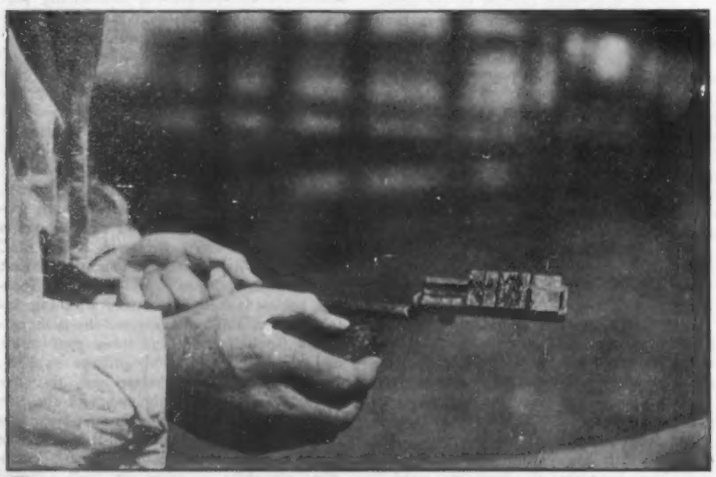
* * *

Beyond Einstein

MATHEMATICS lies at the basis of all the other sciences and a science is regarded as becoming most scientific when it can be treated by mathematical methods. Astronomy and physics reached the mathematical stage first, chemistry is rapidly following suit and recently biology and psychology are making use of mathematics. On account of the fundamental importance of mathematics any advances in this field are welcomed by investigators in every field.

Consequently it is not surprising that the thousand dollar prize offered for a notable contribution to the Christmas sessions of the American Association for the Advancement of Science at Philadelphia, is awarded this year to Prof. G. D. Birkhoff of Harvard for his mathematical paper entitled "A Mathematical Critique of Some Physical Theories." Although the committee contained no representative of the Mathematical Section it picked his paper from the 2,000 that were read during the week.

Only professional mathematicians will understand its significance and it is impossible to present its formulas in ordinary type. So all that can be done here is to show what the paper is about and why it is considered important by experts.



The tattoo blocks, made up of phonograph needles cast in babbit-metal, are inserted in the slotted end of the tattooing instrument

The hog is struck with the tattooing instrument

Geometry was developed into a perfect logical system by the Greeks and until the Nineteenth Century was taught exclusively as the last work in this science. But recently it has been found possible to develop other systems of geometry, equally consistent within themselves. This raised the question whether the Euclidean geometry or some of its newer rivals, the non-Euclidean geometries, best fitted the world as it is. When Einstein pointed out that the non-Euclidean geometry gave a better explanation of other physical phenomena, mathematicians plunged into the new field with greater zest.

Professor Birkhoff has taken a step beyond Einstein. He accepts the four-dimensional view of space and time embodied in the theory or relativity as "reasonably correct qualitatively" but points out that no way has yet been found to account for all the lines of the spectrum of light, which are ascribed to the frequency of vibration of various parts of the atom. The atom was formerly regarded as simple, but is nowadays regarded as composed of positive and negative electrical particles, called protons and electrons, the unlike bodies attracting and the like bodies repelling each other.

But Professor Birkhoff proposes the use of a new type of elastic body and the "new assumption that the electrical forces between the charges on one and the same proton or electron are attractive instead of repulsive." The laws of space and time in the atomic domain seem irreconcilable with the known statistical laws that can be directly verified but he hoped that "the mathematicians would develop various types of mathematical universes which might subsequently be of aid to the physicist."—*Science Service.*

* * *

Mind Arose from the Food Urge

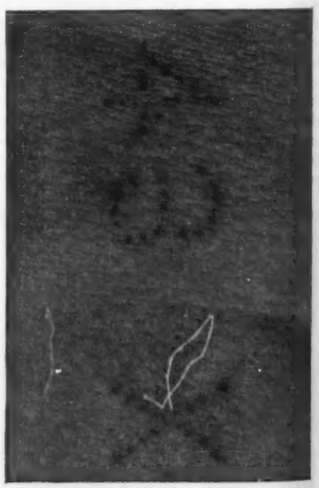
CONSCIOUSNESS, as we know it directly in ourselves, and as it is known to us in the least doubtful examples outside ourselves, seems intimately connected, in some manner, with life, says A. J. Lotka in *Science Progress* (London). Serious interruptions of the normal life processes are commonly accompanied by corresponding irregularities and sometimes by definite interruptions of the stream of consciousness.

This suggests that consciousness is a state of matter, or attends a state of matter, which requires to be continually "excited" by certain life processes, somewhat as the magnetism of the soft-iron armature of a dynamo is maintained by the passage of an electric current through a neighboring conductor. And since one of the most prominent characteristics of life is that it is constantly attended by chemical change (metabolism), the inference readily comes to mind that consciousness is, or attends, a state of matter in the process of chemical transformation.

Further, since the distinction between chemical and physical changes is presumably arbitrary, our inference must be broadened, so that we find ourselves contemplating consciousness as a phenomenon associated with, or attendant upon, matter in a state of stress, or, perhaps, matter in the process of yielding to a stress.

The problem of the ultimate origin of consciousness in living organisms is of course, one of the unsolvable riddles of the universe; but that is not the question before us here. The problem is, rather: "Where and how, in the progress of evolution, did the organism acquire this remarkable and pre-eminently useful quality? The answer is, "The organism did not acquire consciousness at any time; consciousness in some rude form belonged to it from the beginning, as it belongs to all matter. What was evolved was not consciousness itself, but a certain particular type of consciousness, a type of consciousness integrated into or around a more or less clearly defined ego that presides over the behavior of the organism, and imposes unity of behavior.

As to the origin and the mode of development of this particular type of consciousness, we are quite well supplied with at least strong circumstantial evidence. This

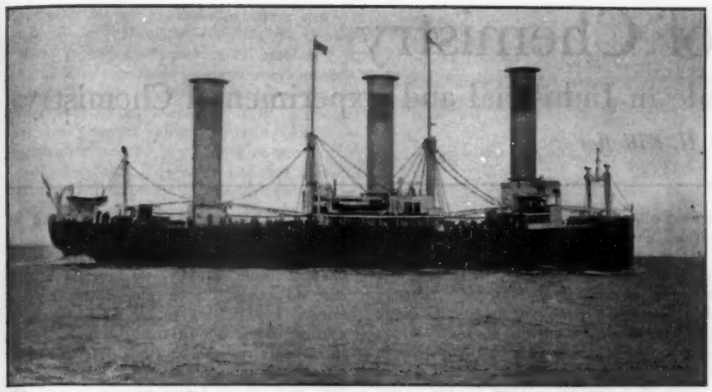


Skin of a hog's carcass after preparation. The tattoo marks are practically indelible

type of consciousness is characteristic of organisms that seek their food actively. Plants, whose food seeps to them by a spontaneous process in which they remain essentially passive, are devoid of those structures which observation teaches us to associate with the integrated type of consciousness.

It may be humiliating to us, but there can be little doubt that we owe our mentality to the necessity of providing food; our mind, whatever may be its functions now, has been developed primarily as a means to fill our stomachs.

We have thus found an answer to the question: "How did living organisms come



The new rotorship *Barbara* on her trial trip. The tall cylindrical rotors are hollow metal shells and are much lighter in weight than the rigging of a sailing vessel of similar size, even though they have a topheavy appearance

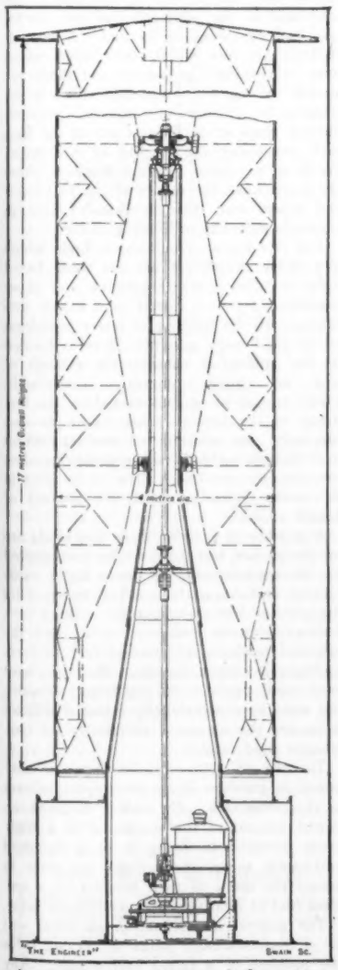
into the possession of consciousness?" They possessed it, according to this view, from the beginning, in common with all matter.

* * *

A Still Larger Rotorship

ANOTHER rotorship, larger and faster than the *Buckau*, which was described in this department in the August, 1925, issue of the Scientific American, has been launched in Germany and placed in freight service, carrying cargoes of fruit between Mediterranean ports and northern Europe. This vessel, 293 feet long and several times the tonnage of the *Buckau* in which a representative of the Scientific American rode in the summer of 1926, is named the *Barbara*.

Instead of the two cylindrical rotors which drove the *Buckau*, the *Barbara* has three; also the rotors themselves have been increased in dimensions in the new vessel from a height of 45 feet and a diameter of 9 feet, to 56 feet and 13 feet, respectively. On a recent trip, these rotors gave the *Barbara* a speed of nine knots or 10.35 miles per hour, according to *The Engineer* (London), in which the new rotorship is described.



A cross-section of one of the rotors

With regard to the principles on which the rotorship functions, it will be remembered that it is continually drawn or "sucked" forward into a partial vacuum formed by air currents rushing past her hollow revolving rotors; that many times as much power is recovered from the wind as has to be expended in order to keep these rotors revolving; that the propeller and engine have absolutely no connection with the rotors, their purpose being for harbor maneuvers and as an auxiliary; and that there is no more mystery in the action of the rotors than there is in the curved path taken by a rotating baseball, the phenomena in either case having exactly the same cause. The rotorship was invented by Herr Anton Flettner, a German engineer, and is based on an aerodynamic principle which has been known for many decades.

The *Barbara* has as sister vessels, except for the rotor installations, two other ships. Each of these is driven, however, by oil engines. The results of the *Barbara's* trial run indicate that, at least under the special conditions of wind direction and velocity demanded by the rotorship, she asks no favors of these sister vessels. With a strong wind (value 6 to 7, Beaufort scale; or 24 to 37 miles per hour) the *Barbara's* speed with both propellers turning, but with all three rotors stationary, was nine knots (10.35 miles) an hour. With the propellers stopped and the rotors turning at 150 revolutions per minute the speed was also nine knots.

The *Barbara* is equipped with a marine oil engine of 1,010 shaft horsepower. She has a beam of 43 feet and a dead weight of 2,830 tons. In the original design it was planned to use only one rotor of large size, but the question of obtaining good bearings for so large a structure under such peculiar working conditions led to the installation of three smaller rotors. Each rotor is kept spinning by means of a 41 brake-horsepower electric motor.

The drive shafts of the rotors are vertical—the driving motors being geared to them at the bottom. They pivot at a point about two-thirds the height of the rotors and have a further supporting bearing at about one-third of their height. The bearings are of the ball and roller type.

The shells of the rotors are built of an aluminum alloy, one-sixteenth of an inch in thickness. They are each supported by nine vertical bridge girders and 23 rings. Thus they are extremely light and do not render the ship topheavy.

On a recent return journey from Italy and Spain to Germany, the best economical running conditions were met when the propellers were reduced to half speed. To this, the rotors added enough energy to raise the speed of the ship enough to equal that given by the propellers alone when running at full speed.

Another rotorship of 11,000 tons dead weight has now been projected by the Flettner Gesellschaft.

* * *

Priest-Astronomer Invents Remarkable Machine

THE Creighton harmonic-motion machine, recently perfected after nine years of work by the Rev. William F. Rigge, S.J., internationally known astronomer, is capable of describing the incredible number of 7,618,782,498 harmonic curves, it is explained in a book, "Harmonic Curves," written by the designer of the machine and just published by the Creighton University, Omaha, Nebraska. The highest number ever attained heretofore by such an instrument was 979.

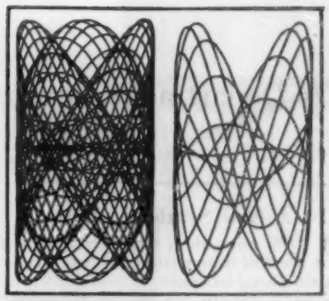
Father Rigge, professor of astronomy and mathematics at Creighton University, made this machine himself, working on it for nine years. He bought all the parts at a cost of about 50 dollars. To duplicate the machine, mathematically perfect, would cost at least 1,500 dollars, he estimates.

The machine contains but sixteen different commercial wheels, duplicates of which are used only in the reduction gear, and it describes 7,618,782,498 curves. The most comprehensive harmonic-motion machine ever made heretofore was the Dechevrens campylograph which took its name from the Greek words meaning "curve" and "I write." The campylograph was designed by Marc Dechevrens, S.J., of Jersey, England, and there were but 979 possible combinations to be made by it.

The author believes the book will appeal to readers of many classes. To those who are fascinated by the beauty of the curves or by the agreeable surprises that their generation creates, hints are given as to how this beauty may be produced and increased. Those endowed with mechanical genius will learn how to construct their own machines. Mathematicians will be delighted by the simplicity of the equations of the curves. Father Rigge's book may be called a pioneer work, having the avowed object of encouraging the study of harmonic curves.

Father Rigge has been connected with the Creighton University since it was founded, nearly fifty years ago. He has a well-equipped astronomical observatory on the Creighton campus. He is the author of "The Graphic Construction of Eclipses and Occultations," and many other works on astronomy and mathematics.

Seventeen years ago an Omaha man was accused of placing a bomb under the porch of a well-known Omaha politician. The bomb had exploded without loss of life. The State's witnesses swore that they saw the accused place the bomb under the porch and fixed the hour of the day at 3:22 on a Sunday afternoon. One year later, during the trial of the accused, Father Rigge proved by means of the shadow on a building in a photograph that the State's witnesses were several miles from the scene at the time the bomb was placed. The photograph used as evidence showed the State's witnesses, as members of a confirmation class of an Omaha church.



Examples of some of the many harmonic curves inscribed by the extremely ingenious mechanism of Father Rigge's machine

By measuring the shadow, Father Rigge fixed the exact time that the photograph was taken. The case was nulled and the accused was freed.

* * *

New Wind Record Set in Florida Hurricane

A NEW record for wind velocity recorded by weather bureau instruments was set by the Miami hurricane on September 18, 1926, Benjamin C. Kadel, in charge of instruments at the Weather Bureau in Washington, told members of the American Meteorological Society at the Philadelphia meeting of the American Association for the Advancement of Science.

At 7:40 A.M., the wind blew with a speed of 132 miles an hour, which was the highest velocity recorded then, or ever before, he said. This speed corresponds to a pressure of 57 pounds per square inch. Thirty-two minutes later the wind gage was blown down.

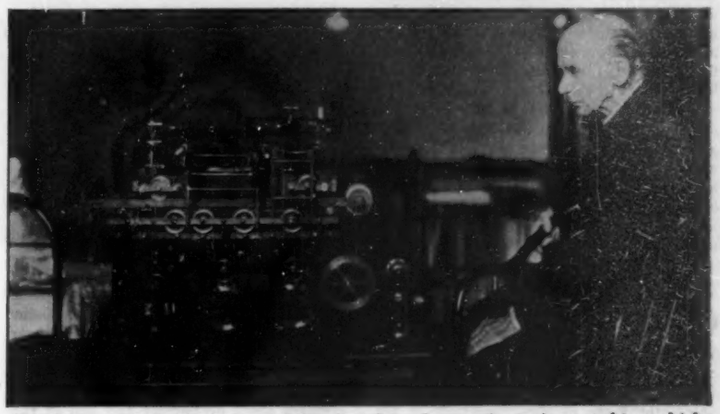
The significance of this record, Mr. Kadel said, is that the center of the storm passed within a mile of the wind gage, and that this gives engineers some idea of how fast the wind blows within a hurricane.—*Science Service.*

* * *

Extension of Life Worth Billions

BEHOLD the cash value of living longer than our grandfathers did! The increase in earning power of our population in this generation for men alone amounts to 2,300,000,000 dollars per year. Accurate data on the earning capacity for women is lacking but estimates made by statistical experts of the Metropolitan Life Insurance Company put the total increase in earning power since 1901 at 3,500,000,000 dollars.

This gain in ability to earn money has come about as the result of the recent improvement in extension of life, the experts declare. In 1901, a male at birth was considered to have a potential worth of 7,553 dollars, but in 1924 the value of the average baby boy was calculated at 9,333 dollars. The gain of 1,780 dollars potential value at birth is due to the longer life an individual can now be expected to live with a consequent longer period of earning capacity.—*Science Service.*



The Reverend W. F. Rigge and his Creighton harmonic-motion machine which is capable of drawing 7,618,782,498 separate curves

In the World of Chemistry

A Department Devoted to the Advancements Made in Industrial and Experimental Chemistry

Conducted by D. H. Killeffer

A New Synthetic Resin

A NEW resin which may be molded and handled in very much the same manner as the phenol-formaldehyde resins familiarly known as bakelite has recently been developed by the Diamond State Fibre Company of Bridgeport, Pennsylvania. It consists of the polymerization product of phenol and glycerol. In describing the new resin at a recent meeting of the American Chemical Society, James McIntosh gave the following directions for its preparation which may interest the experimentally inclined:

"The novelty of the new resin is that it is formed by the reaction between glycerol and phenol. This reaction is easily controlled. On a commercial scale it is carried out in a pressure-jacketed autoclave, provided with a mechanical stirrer and so equipped that it can be steam-distilled under vacuum. In the laboratory, the reaction can be studied in a glass flask or in a pressure bomb. The following is a typical illustration:

"Place 1,000 grams of chemically pure crystal phenol, 700 grams of chemically pure glycerol (specific gravity, 1.25), and 10 cubic centimeters of sulphuric acid (specific gravity, 1.84) in a round-bottom, short-neck, 2-liter flask. Place a thermometer through the cork into the solution and heat the flask over a direct flame, holding the temperature between 160 degrees and 190 degrees, Centigrade. As fast as the water of reaction is formed, it is fractionated off through a 2-bulb stillhead filled with glass beads, connected with a water-cooled condenser. During the reaction, some phenol is carried over. From time to time separate the phenol from the water in a separating funnel and return to the original flask. When approximately 350 grams of water have been distilled, allow the reaction flask to cool slightly and neutralize any acid with barium carbonate, calcium carbonate, or calcium oxide. Calcium or barium compounds are preferable because they give insoluble sulphates, which do not impair the dielectrical properties of the resin.

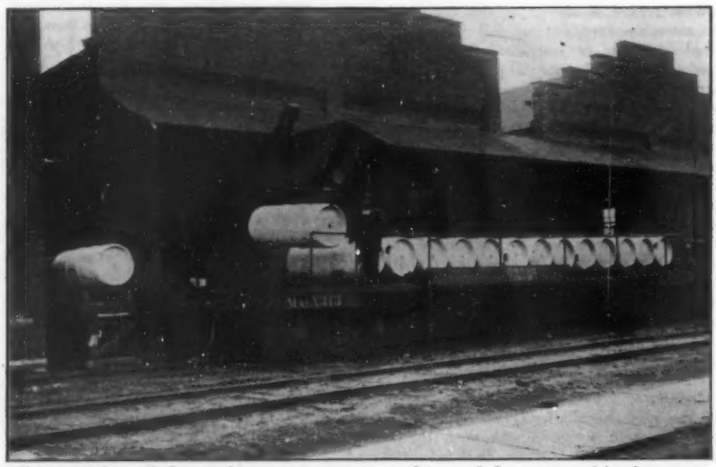
"In carrying out this reaction it is helpful to use an excess of phenol; otherwise the resin has a tendency to be rubbery or slightly insoluble. The use of an excess of phenol is commercially feasible as it can be recovered and used again. On the other hand, a slight excess of glycerol impairs the hardness and is detrimental to dielectric and other properties of the resin.

"The foregoing reaction is a progressive condensation, and can be stopped at different stages. The yield will vary somewhat, depending upon how far the reaction has been carried. At the beginning of the reaction there is a watery, white, limpid solution, which gradually changes to pink and finally to a deep, dark, almost black resin, solid at room temperature. If the acid catalyst is not neutralized, heat alone will easily cause the condensation to carry over to the insoluble, infusible state.

"This new synthetic resin can be heated over a direct flame to 325 degrees Centigrade, or even higher after the acid has been neutralized. At this high temperature the resin will pour with water fluidity and on cooling, it will set hard, with a brilliant luster, easily soluble in alcohol, acetone, and other solvents."

Industrial Gases

GASES in compressed and liquefied form are important articles of commerce and within the last few years their use has increased enormously. In 1923 (the last year for which complete census figures are available), the value of these materials in the United States was 54,000,000 dollars as compared with approximately 10,000,000 dollars in 1913. More than two billion cubic feet of oxygen, more than 45 million gallons of liquid nitrous-oxide, more than 522 million cubic feet of acetylene, nearly 104 million cubic feet of hydrogen, nearly 24 million pounds of liquid ammonia, 125 million pounds of chlorine, six and a half million pounds of sulphur dioxide and 51 million pounds of carbon dioxide go to make up the business in compressed gases done in the United States. In addition to these, propane used as fuel, helium for aircraft, argon and neon in electric lighting, and ozone for water purification were of considerable value. One ordinarily thinks of gas in connection with a balloon, the kitchen stove, a visit to the dentist or chemical warfare, but the widespread use of various gases in industry has added many new applications for the term "gas" in commerce. Not only are huge quantities of gases now consumed, but each year develops new and larger uses for them.



Chlorine, first of the modern war gases, is used in such large quantities in peace-time industries, that tank cars are required for its shipment

Protecting Wood from Moisture

THE problem of preventing the warping and twisting of wood under varying conditions of moisture is a serious one for all users of this important material. Recently the Forest Products Laboratory of the United States Department of Agriculture has undertaken to study this problem carefully and some of the results of tests of various protective coatings are reported by M. E. Dunlap in *Industrial and Engineering Chemistry*. The tests made were conducted with the idea of determining the value of different types of wood coatings in preventing warping of test specimens under various moisture conditions. The conclusions reached are summarized by Mr. Dunlap as follows:

"Linseed oil is commonly considered to be an excellent moisture-proofing material, but we have not found it so. We have tested it in many ways—by brush coating, dipping, soaking, and by impregnation under pressure.

"Wax coatings similar to those used on floors do not rate high in moisture-proofing value.

"While we have not made a detailed investigation of the effect of various constituents of coatings, some rather significant points are brought out in our studies. Spar varnishes are low in moisture resistance as compared with rubbing varnishes. For instance, the efficiency of spar varnish, when new, averages about 57 percent and that of rubbing varnishes, 88 percent. Apparently the greater amount of gum present in a rubbing varnish accounts for the difference.

"The addition of a pigment to a varnish or oil increases its efficiency in keeping out moisture. An oil paint is far more effective than linseed oil alone and an enamel shows a marked improvement over varnish.

"Aluminum powder is very effective in keeping out moisture when used in the preparation of a coating. When freshly mixed with the vehicle, it leafs out, forming a very effective barrier against moisture changes. Probably the most striking illustration of its value is in raising the efficiency of bronzing liquid on first exposure from about 12 percent to 92 percent, a gain of 80 percent. Addition of aluminum powder also increases the efficiency of spar varnish by about 40 percent. From one to two pounds of powder are required to the gallon of the vehicle.

"The majority of asphalt and pitch paints have good moisture resistance. Their efficiency, however, may also be improved by the addition of 10 to 20 percent of aluminum powder. In some cases the powder will leaf out and rise to the surface, hiding the black color.

"Probably the most effective protection against moisture changes is the aluminum-leaf coating. This process simply incorporates a layer of aluminum leaf in the coating and provides a very strong barrier to moisture. The efficiency of this coating is about 98 percent. It was developed particularly for use on airplane propellers, where very slight changes in moisture content are important.

"Cellulose lacquers have an efficiency of a little over 70 percent when new, and cellulose enamels about 5 or 6 percent higher.

"Shellac has a remarkably high moisture-proofing value of about 88 percent—but does not stand up very well when subjected to the weather.

"It is important to know that none of our ordinary coatings is absolutely waterproof. All permit the passage of moisture to some degree, and if extreme conditions persist over a considerable period of time, injury may result to glue joints and woodwork which they cover."

In conclusion, Mr. Dunlap adds a precaution to manufacturers who seek to prevent warping when applying a coating to one side only of the article to be protected. He says:

"Few manufacturers realize the effect that coatings may have on warping. In many kinds of goods, one surface of a panel is finished with a very effective coating while no attention is paid to the back. When moisture changes take place, the gain or loss of moisture is greater from the exposed side than from the coated side and if the changes occur rapidly, warping is almost sure to result. Such difficulties may be avoided by applying to the backs a cheap coating which will balance the face coating in moisture resistance. Such practice would reduce the rate of change in moisture content and permit better equalization of absorbed moisture."

Anti-Knock Fuels for Motors

ANTI-KNOCK fuels will form an item of great importance to motorists during the approaching summer season and it may be worth while to consider the value of these to the average automobile owner. It is well known that the knock encountered in an automobile engine when working under load or when badly carbonized materially reduces its efficiency. Engines are designed to take full advantage of the explosion in the cylinder and necessarily operate at a point only slightly removed from knocking under ordinary conditions. Because of this, the use of anti-knock fuels in an ordinary motor increases its efficiency as measured in the number of miles per gallon obtained from the fuel. No one knows definitely what knock is or how the various fuels now in use prevent it, but the important point is that they do.

The possibilities in greater fuel efficiency are bound up primarily in the design of the engine and car in which they are to be used and in the adaptation of the car to take full advantage of its fuel. A number of fuels are now widely distributed which have "anti-knock" properties and these are already having a considerable effect in increasing the efficiency of automobile engines. Several types of such fuels are to be had, each possessing the quality of preventing knock to a certain extent. Some of these are based upon the nature of the fuel itself and others owe their anti-knock value to materials added to ordinary gasoline.

The two types of anti-knock fuels which now enjoy the widest use are those based upon so-called cracked gasoline and those containing tetra-ethyl lead as a knock preventive. In the cracking of heavy petroleum oil to yield more gasoline, there is formed in the product a considerable amount of what are called unsaturated compounds. These appear to operate to reduce the tendency of the fuel to cause knock in use. Similarly, the addition of coal-tar benzol to form benzol blends with ordinary gasoline increases the anti-knock value of the fuel to an extent depending upon the amount of benzol added.

A number of fuels of these two kinds are on the market, but the difficulty encountered by the manufacturer in producing a satisfactory, uniform, anti-knock fuel by cracking his gasoline has prevented the striking of a balance between anti-knock value and the disputed tendency of cracked fuel to form undesirable carbon deposits. Motorists have used such fuels with satisfactory results, but some have occasionally found it difficult to secure the necessary uniformity for continuous good results.

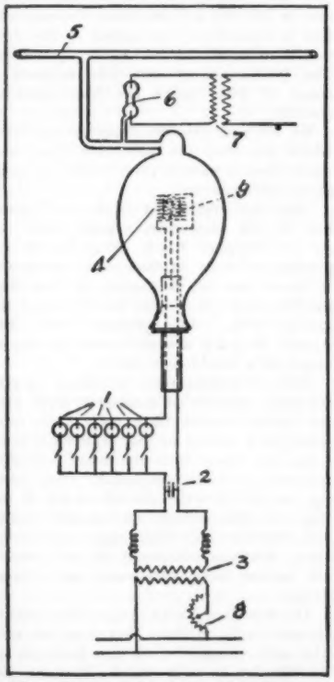
The use of tetra-ethyl lead as an anti-knock in gasoline is apparently not subject to this drawback. By adding a pre-determined amount of the compound to a high-grade gasoline to bring it to a standard anti-knock value, the refiners are able to assure the users of their product of a uniform fuel of relatively high anti-knock value.

The general use of anti-knock fuels will be of unquestionable value in helping solve the problem of a future fuel supply. Any

increase in the use obtained from a given amount of fuel is equivalent to the production of just that much more gasoline. If, as is easily possible without other change, the efficiency of our automobiles can be increased by an average of even 1 percent of its present value, the result will be equivalent to the production of nearly 100 million gallons of gasoline per year in addition to that already produced. This apparently trifling saving of 1 percent of the gasoline used by American automobiles would be equivalent to an addition to the product of our oil wells of some seven million barrels of oil per year. One cannot avoid the conclusion that such a voluntary saving by the automobiles themselves would go a long way toward postponing any possible oil famine.

Metallic Thorium

DUCTILE metallic thorium has recently been prepared in the laboratory of the Westinghouse Lamp Works in commercial quantities and bids fair to become an important article of commerce. It is used in the manufacture of filaments for radio tubes and targets in X-ray tubes. In its manufacture, the powdered metal is first prepared and compressed into shape for heat treatment. The latter is carried out in a furnace consisting of a large glass bulb—a decided innovation in metallurgical furnaces.



The thorium heat-treating furnace which is described in the text

The accompanying diagram shows the equipment originally used, which consists of a glass bulb fitted with a ground stopper which is sealed to a press through which pass leads to vacuum mercury spark gaps (1), condenser (2), and transformer arrangements (3), for the production of high-frequency currents. The coil is represented by (4), within which is a support of pure thorium oxide, upon which the samples were heated. The tube (5) is connected to mercury diffusion pumps and the spectrum tube (6) is connected to a transformer (7) which gave 3,400 volts for the purpose of detecting the degree of vacuum. The high-frequency current can be controlled by a rheostat or choke coil (8) in the primary of transformer (3).

New Source of Hafnium

THE world's richest source of hafnium, a newly discovered element which is already showing itself useful, has been discovered in the Bedford quarry in Westchester County, New York.

Smoothing the Way

Manganese steel frogs and switches are smoothed by the GRINDING WHEEL—no metal tool can work this hard, tough alloy with success.

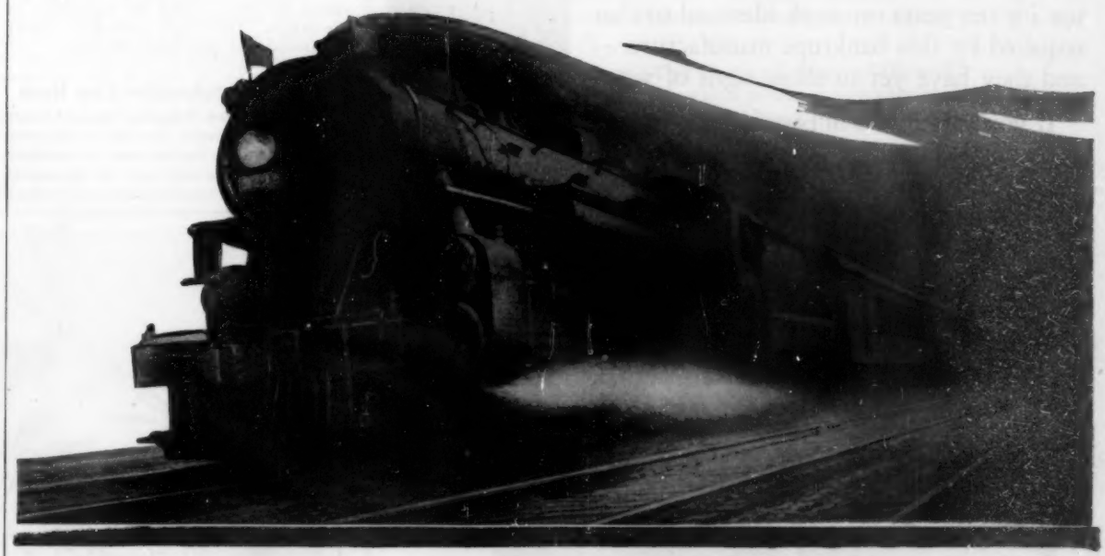
Car wheels are ground true and concentric on mammoth machines of Norton design.

Piston Rods, Pins, Car Axles, Air Brake Parts, Guide Bars, Links—GRINDING has an important part in their production and maintenance.

Thus GRINDING is rendering the traveling public a great service—

the limited express meets its fast schedule.

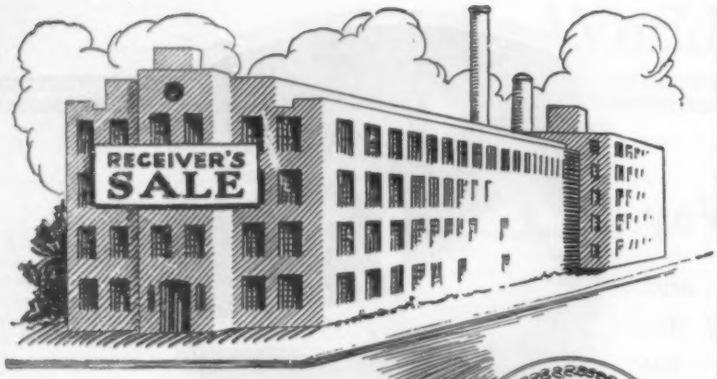
NORTON COMPANY
Worcester - Mass.



NORTON

Grinding Wheels
Grinding Machines

Refractories-Floor and Stair Tiles



½ Cent More and it wouldn't have happened

THE manufacturers of a nationally-known household appliance recently went into the hands of a receiver. Bankrupt for half a cent!

They built a good product—good in every respect but one. The bearings would not stand up, and literally thousands of machines were turned back to their distributors with a loud-voiced complaint and unpaid bills.

This $2,000,000 concern used an oilless bearing that cost 2½ cents. Argutos would have cost them 3 cents, but they couldn't "see the difference" and decided to *economize!* What they actually saved just about paid for the "Receiver's Sale" sign they were forced to erect.

Arguto Oilless Bearings have been in use for ten years on work identical to that required by this bankrupt manufacturer—and they have yet to show signs of wear.

If your product will benefit by a bearing that costs ⅙ that of bronze and never needs a drop of oil or a moment's attention, *write us for detailed information.*

ARGUTO OILLESS BEARING CO.
Wayne Junction Philadelphia, Pa.

Arguto OILLESS BEARINGS

ARGUTO OILLESS BEARING CO.
Wayne Junction, Philadelphia, Pa.

Please send me information and facts about Arguto Oilless Bearings.

Name .....

Address .....

City and State .....

Aircraft are being put to use in peace as well as in war. This department will keep our readers informed of the latest facts about airships and airplanes

Conducted by Alexander Klemin

In charge, Daniel Guggenheim School of Aeronautics, New York University

Combined Rudder and Brake Control

THE Stinson-Detroiter is a very fine commercial plane of thoroughly modern design, equipped with a Wright Whirlwind engine and capable of carrying a useful load of 1,200 pounds at a top speed of 125 miles per hour. It is claimed by the makers that this is the first plane ever equipped with individual brakes on each wheel. In conjunction with a self-starter, the brakes make for easy handling on the ground, a landing run of only 150 feet, and the same facility in making a get-away as with an automobile.

With a combined rudder and brake control, ground maneuverability is greatly increased; for a rapid turn to the right, right rudder is combined with a locking of the right wheel. The combination arrangement is illustrated in the diagram. This represents a "dual" control installed in usual fashion in the fuselage. The pilot's feet are placed in the pedals, E. Moving the feet back or forward rotates the rudder bar, C, and the rudder post, A, and communicates suitable motion to the control wires, I, which go back to the rudder horns. Depressing the toe of the foot rotates the arms, F, and moves one of the wires or cables, G, which causes the application of the brakes. This simple control is entirely mechanical and thoroughly effective.

Italy Wins Schneider Cup Race

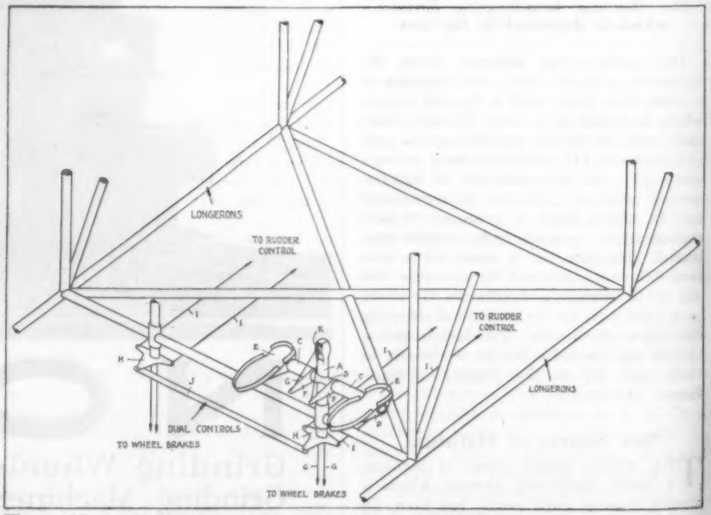
IN 1912, Jacques Schneider donated a cup to aviation circles that was to be used for stimulating international competition and which was to pass into the permanent possession of the country which won it three times in a period of five years. This has not yet happened. Although Italy has won the race twice before and also won the race this year, the time limit has been passed and the cup is still open to competition. It is interesting to note that the cup was won first in 1913 by a Frenchman, Prevost, who flew a Deperdussin monoplane at the then marvelous speed of 44.7 miles per hour. The Italian winner this year achieved a speed of 246.4 miles per hour—quite a contrast!

We will pass over the disastrous accidents which preceded the race this year, and which seem a painful price to pay for even great achievements.

After the elimination trials, on November 13, six contestants actually took the air at Hampton Roads, Virginia, in the presence of some 30,000 excited spectators. If there was any advantage, it was that the American pilots were better trained for racing work. In particular they had trained in going around corners in expectation of a hard-fought race.

There is nothing more calculated to give the most experienced aviators a thrill than the almost vertical bank made in a turn, when for a second or less centrifugal force forces the blood from the brain and consciousness partially disappears. Their training showed up well; the Americans in the race cut their corners very sharply indeed and certainly beat their opponents on the turn. But this refinement of skill availed not against more horsepower and cleaner designs.

The American Navy-Curtiss racers were of similar design to those that won last year. The only change lay in the mounting of the Curtiss V-1550, which develops 700



The rudder and brake controls of the Stinson-Detroiter commercial airplanes are combined on the rudder bar in this manner

Courtesy Aero Digest

The *Curtiss* 1926 racer, equipped with a V-1550 motor

horsepower at 2,600 revolutions per minute and only weighs 750 pounds—a remarkable product of ingenuity and refinement. The Curtiss R3C-4, as this plane was called, piloted by Lieutenant Cuddihy, would certainly have landed second. Unfortunately on the last lap the fuel pump which brought up the fuel from the pontoon tanks failed to function, and the perfect engine ran dry! Lieutenant Schilt, who finished second, had last year's winning plane, and finished at an average speed of 231.363 miles per hour.

By no skill could Schilt have beaten Major Mario de Bernardi in his Macchi-Fiat seaplane. De Bernardi made a world's record of 246.4 miles per hour on the triangular course of 50 kilometers (217.483 miles in all), beating even Doolittle's straightaway record for a seaplane.

The superiority of the Italian craft lay partly in its being a monoplane, with a wing no thicker than that of the American biplane, but with carefully arranged wire bracing running from the top of the fuselage and from the pontoons to the outer points of the wing, and partly in the fact that the huge Fiat motor actually developed 800 horsepower or 100 horsepower more than its most powerful American competitor.

Both land- and seaplane speed records are now held by monoplane designs. Perhaps American designers had rested a little on their laurels in banking on the continued supremacy of the biplane. Perhaps also sufficient appropriations had not been forthcoming to build an entirely new monoplane design, and an entirely new engine exceeding even the V-1550 in power.

A New York Airport

NEW YORK CITY is now perhaps the only large city in the United States still without a recognized airport in close proximity to its center. Owing to the congestion of the metropolitan area, and the high value of real estate, a satisfactory solution has been hard to find. The Merchants' Association of New York City, after years of exhaustive study, now suggests 400 acres of marsh land at Secaucus on the Jersey side, across the Hudson River, but only three miles from the Pennsylvania Station.

Most New York air traffic will come from the west and the site is geographically ideal. It is estimated that the airdrome can be established for 2,500,000 dollars. The marsh must be drained and built up. Two salt water streams enter it at opposite sides. The plan is to employ hydraulic filling, dredging out of one section to fill in another. It is said that one acre will fill five others by this process, at an average cost of 2,000 dollars an acre.

In the end there would be at least 400 acres of field with five feet of additional soil. The operation would at the same time create a water basin of approximately 100 acres, adequate for seaplane landings.

The City Board of Estimate is looking into the project. If the political difficulty of having New York City buy land in New Jersey cannot be removed, private ownership and operation may follow. Whatever the method, the need is imperative. The lack of a suitable New York airport is perhaps one of the greatest hindrances to the development of commercial operation.

Pan-American Flight Equipment

THE Army Air Corps, in its Pan-American flight with five Loening Amphibians, has shown the same meticulous care in organization and advance work as in the round-the-world flight. As a result, the trips were comparatively uneventful, and were adequately described in the daily press.

Each effort of this kind is valuable in bringing to light some new piece of useful equipment. The unfortunate navy flight from San Francisco to the Hawaiian Islands demonstrated the necessity of some signaling device to be used when power for radio failed. The Loening Amphibians have been equipped with a signaling kite of considerable interest, designed by Samuel F. Perkins of Dorchester, Massachusetts.

We usually associate a preliminary run

(*Continued on page 206*)

International Newsreel

Major Mario de Barnardi, Italian ace, in his Italian Macchi-Fiat seaplane, which won the Schneider Cup, flying at a record speed of 246.4 miles per hour, in spite of 21 turns over a triangular course

Plylock trunks are better, and cost less to build

Plylock—"wood that's stronger than wood"—is the ideal trunk material—inexpensive enough for use in the modest locker trunk, light enough for hand luggage, and more than fine enough for the very best wardrobe trunks.

It is remarkable in its ability to withstand shock and resist rupture. Its laminated construction eliminates warping and cracking. It is easily worked, and may be nailed, sawed, mortised and bent, with minimum labor costs.

Trunk manufacture is but one field of many in which "Plylock" raises quality and lowers cost. Manufacturers of automobile bodies, of cabinets, shelving, paneling, doors, toys and novelties, desks and furniture, and innumerable other lines, are finding that it pays to substitute Plylock for lumber or ordinary plywood.

Write for a copy of "The Pictured Story of Plylock" and full information about this product. Samples gladly sent for experimental work at your own plant. Our research department is at your service.

PORTLAND MANUFACTURING CO., PORTLAND, OREGON
Plywood makers for 27 years.

PLYLOCK

"Wood that's *stronger* than wood"

1 OUTER LAYER GRAIN LENGTHWISE
2 CENTER LAYER GRAIN CROSSWISE
3 OUTER LAYER GRAIN LENGTHWISE
4 WATER RESISTING PLYLOCK GLUE
The pictured story of PLYLOCK

Send for this Book—Your Copy of "The Pictured Story of Plylock" is ready Write for it.

3-ply Plylock cut away to show construction. Plylock is regularly made in 3 and 5 plies of finest Douglas Fir.

Delightful

Here is a new treat for you. As bracing as the wind—as exhilarating as a shower bath.

Listerine after shaving. Simply douse on the face full strength.

Immediately it sets you up. Your whole face feels cool, soothed, yet invigorated. There is an amazing sense of exhilaration you'll like.

If the razor scrapes, Listerine stops the smarting. If the face burns, Listerine cools it. And you are left with a nice feeling of safety — for Listerine contains antiseptic ingredients that lessen the danger of infection.

Just try Listerine this way the next time you shave. We'll wager you will be as delighted as those happy ones who have written us letters about it. Lambert Pharmacal Company, St. Louis, U. S. A.

THEY STICK TO IT! The way we get new users for Listerine Tooth Paste is to get people to try it just once. After that they rarely switch.

LARGE TUBE—25 CENTS

and as an

ASTRINGENT

Inexpensive

Here's good news for any woman who has rebelled at paying the remarkable prices usually charged for astringents.

Listerine is a natural astringent, neither too harsh nor too weak. One that is safe for all types of skin, yet ridiculously low in cost.

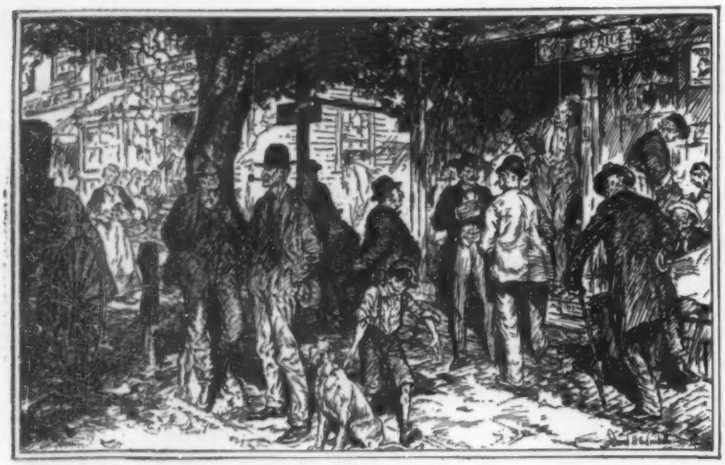
After removing the cream you merely douse it on the face full strength. Dilute if you prefer.

You can feel it firmly closing the pores. You can feel it draw up lazy, sagging muscles. Your entire face is stimulated. You look — and feel — younger.

So many women have told us how delighted they are with Listerine used this way that we want you to know about it. Lambert Pharmacal Company, St. Louis, U. S. A.

R I N E

— the safe antiseptic



The Meeting Place

An Advertisement of
the American Telephone and Telegraph Company

IT IS not so long ago since people met in town hall, store or at the village post-office, to talk over matters of importance to the community. Then came the telephone to enable men to discuss matters with one another without leaving their homes.

With the growing use of the telephone, new difficulties arose and improvements had to be sought. Many of the improvements concerned the physical telephone plant. Many of them had to do with the means of using the apparatus to speed the connection and enable people to talk more easily.

This need for improvement is continuous and, more than ever, is a problem today. Speed and accuracy in completing seventy million calls daily depends upon the efficiency of Bell System employees and equipment as well as upon the co-operation of persons calling and those called and numerous private operators.

It is not enough that the average connection is made in a fraction of a minute or that the number of errors has been reduced to a very small percentage.

The American Telephone and Telegraph Company and its associated Bell Telephone Laboratories have practically for their sole task the making of the telephone more serviceable and more satisfactory—as a means of conversing with anyone, anywhere, any time.

BOLENS Garden Tractor

Does Garden Plowing, Seeding, Cultivating and Lawn Mowing with great saving of time and effort. All it needs is a guiding hand. Gasoline power

does the work. Attachments for different jobs are instantly interchangeable. Many indispensable features, patented arched axle, tool control, power turn, etc. Ask about our time payment plan. Write

GILSON MFG. CO., 604 PARK ST., PORT WASHINGTON, WIS.

Magnified 225 Diameters

This is what the tip of a fly's leg is like when seen through the

ULTRALENS MICROSCOPE

At last a high powered microscope is within the means of all who wish to study, observe and experiment with the vast world of minute objects invisible to the naked eye. Such fun it is, as well as educational. No technical training required, yet hundreds of scientists and teachers are using this instrument. Gives enormous magnification and perfect definition. Send $7.50 for complete outfit. Send for descriptive literature.

$7.50 for Complete Outfit Prepaid

SCIENTIFIC APPARATUS CORP. Dept. 102 Milton, Pa.

BIG PROFITS in a NEW BUSINESS

Helping Motorists Save ⅓ Their Tire Bills!

Even if you are making "good money", you can greatly increase your income in a new all-year-round business of your own where you will be steadily building larger and larger future profits—limited only by your efforts. You can pay out of your earnings. Already, throughout the world, hundreds of ambitious men have begun to realize the very large profits to be made in this new uncrowded branch of the Automobile field—now opened up because of the famous

NESTLER RUBBER FUSING PROCESS

Only a Nestler Operator is permitted to perform the Process and only one Nestler Operator is permitted to operate in any community. The automobile owner can now obtain 70% more mileage from tires he usually throws away. For the first time new rubber is perfectly fused directly to the old thread. Old tires can now be made practically new.

EASILY LEARNED — GET THE FACTS

NESTLER RUBBER FUSING CO. INC.

Dept. C-2, 245 West 55th Street, New York City, N. Y.

INVENTIONS PERFECTED
MODELS MADE
In a fully equipped machine shop
Manufacture Dies, Tools, Jigs and Fixtures of Precision
Let us manufacture and act as your factory

Moore & Co. 201 W. Grand Ave. Chicago, Ill. Tel. Del. 1819

WANTED

Company to buy or manufacture on Royalty basis, All Steel and Plate Glass, Patented Show and Wall Display Cases. Far superior to the old wood show cases. A wonderful opportunity for unlimited results. Address L. R. Himes, New Bethlehem, Pa.

with the flying of a kite. However, the Perkins kite is so carefully designed and balanced that, given a moderate wind, it can be released from the ground and flown aloft without any preliminaries. If the Loening plane should happen to alight, disabled and in desolate waters, the kite, aloft with its flags, will be seen for a distance of 25 miles.

It is interesting to see how one of mankind's oldest toys is still being put to useful service. Even on board a battleship or a merchant vessel, the kite may perform signaling duty at times. Towards the end of the war, the Germans had designed and tested a man-carrying kite, which was to be carried aboard their submarines.

The Loening Amphibians will also carry a new type of automatic fire-extinguisher. This has been installed under the cowling of the engine in space which would otherwise be wasted. From a central tank, which contains about two quarts of chemical under pressure, a series of small pipes radiate to the fuel tanks and engine. Excessive heat in any of the danger spots will immediately release a mass of fire-extinguishing chemical. A hand control also is provided. This is located in the pilot's cockpit.

Wide World

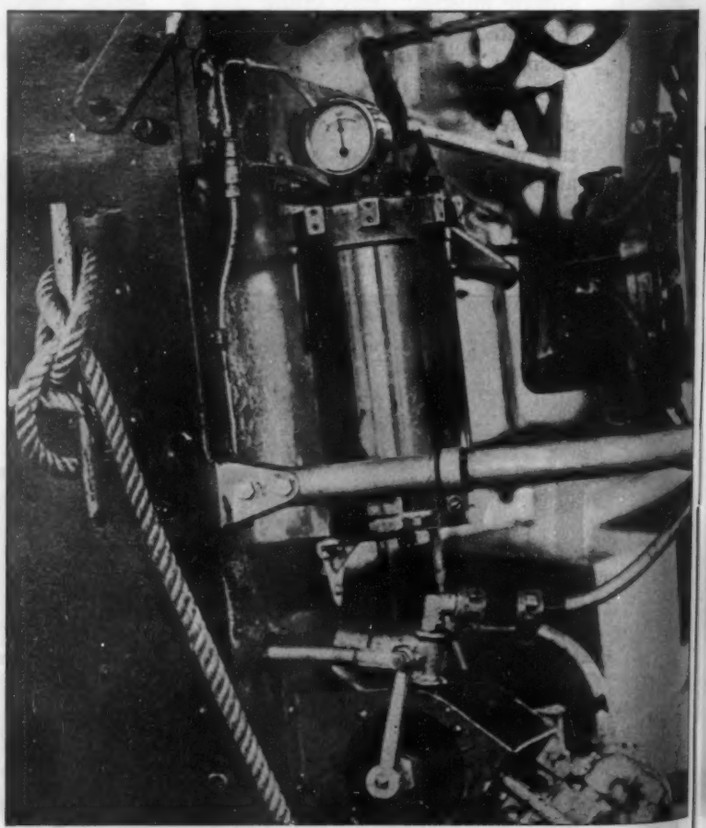
The Perkins kite aloft with various signal flags

A Balloon Propaganda Distributor

"FREE and Captive Balloons" by Ralph H. Upson and Charles De Forest Chandler (Ronald Press, New York), contains a wealth of original information on this subject, presented in a clear and authoritative manner. One interesting device, among many others, which we have not seen described in any previous publication is the "propaganda balloon," invented by Captain R. C. Pierce of the United States Army Balloon Division during the latter part of the World War.

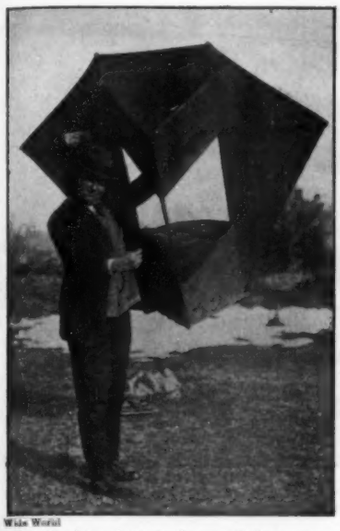
The improvised propaganda balloons formerly used by both sides consisted only of heavy paper, varnished to hold gas a few hours at most. A few circulars were attached to a wire, and the wire was clamped with cotton wicking that burned away slowly without flame, soon releasing the sheets.

The Pierce distributor is a far more endurable and better working mechanism. From a free balloon of about 4,000 cubic feet volume, a light framework is suspended by a 3/16-inch cord. This cord is gripped tightly between friction rollers and the weight of the apparatus provides the motive power, gradually passing the cord between the rolls. The speed is regulated by a governor similar to those used on talking machines. An upper and a lower shaft are geared to the rolls. Sheets of printed matter are punched at the top with a 7/8-inch hole, and the upper threaded shaft moving slowly through this hole pushes off the sheets at the rate of 20 per minute. The lower shaft is provided with a coarse thread and one revolution discharges a comparatively large number of sheets.



Henry Miller

The new type of automatic fire extinguisher which has been installed on the Loening Amphibian planes for the Pan-American flight



Wide World

The Perkins kite to be used for emergency signalling on the Pan-American flight. It can be flown in a moderate wind without a preliminary run

The lower shaft acts only when the balloon starts to descend. A descent of from 40 to 60 feet increases the air pressure which closes an electric circuit, actuates a solenoid and allows the lower shaft to make a revolution, discharge many sheets and so restore equilibrium. Without this action the balloon might drop unchecked to the ground. The Pierce balloon carries 14,000 sheets, each eight and one-half by twelve inches. An interesting refinement is found in an additional mechanism which destroys the device on contact with the ground and thereby ensures that the balloon shall not be employed for counter-propaganda by the enemy.

A Gigantic Flying Boat

THE French have found their airlines between the south of France and their provinces in northern Africa to be the most useful. In four or five hours flying, their seaplanes cross the broad expanse of the Mediterranean Sea which steamers take a day and a half to traverse.

Large, seaworthy, flying boats, with multiple engine-units as a security against forced landings, are the obvious type to employ for such work, and the Richard-Penhoet flying boat, recently completed, certainly meets the specifications. It is equipped with five Jupiter air-cooled engines of 420 horsepower each. Eight tanks with 110 gallons of gasoline in each give seven hours' flight at full throttle. Unloaded, the plane weighs 25,300 pounds; with useful load the weight runs up to something over 19 tons.

The wing span is 131 feet. The chord tapers from 29 feet, six inches at the root to 16 feet, five inches at the tip. If any other proof of huge dimensions is needed, it may be stated that the maximum wing thickness is five feet, ten inches, providing good headroom for the average man.

The design of the boat involved many engineering problems, particularly in balance and control. As a matter of fact, the horizontal tail surfaces are 471 square feet in area, sufficient for the ordinary Liberty-engined plane.

All controls are carefully balanced and can be operated by hand in spite of their huge dimensions, but for long flights, a hydro-electric servo motor is employed. It is to be expected that, as flying boats increase in size, some form of servo motor for control will become inevitable.

Mere size brings certain advantages in its train; thus, the hull structure can be made five-eighths of an inch in thickness, its plywood covering of spruce, birch and teak providing real resistance to the shock of the water. In the new flying boat, in addition to the pilot, a navigator is carried in a cockpit which is built above the wing. The passenger cabin placed under the wing has a seating capacity of twenty.

Sir Alan Cobham

ALAN COBHAM, famous British aviator, at the completion of his flight of 28,000 miles to Australia and back, was knighted by King George. A wonderful long-distance pilot, his job for the last five years with the De Haviland Company of England has been that of "aerial propagandist." He is convinced that flying should now be a general matter.

Sir Alan, now on a lecture tour in the United States, speaks most powerfully on this topic. We have had the pleasure of listening to some of his arguments and they are unanswerable. We thought that his analogy between the bicycle and the airplane was particularly striking. In the early days of the bicycle, he said, riders were painfully taught. Now riding a bicycle seems to be instinctive with every boy. Sir Alan thinks that the same instinctive sense of flying will be found in the younger generation.

Cobham backs his views by flying where and when he wills. On his arrival in the United States, he was to fly ashore from Sandy Hook in his small *Moth*, provided with floats for the occasion. The sea proved too rough for this feat. However, the De Haviland *Moth* has carried Sir Alan and Lady Cobham over much of the United States without any difficulties.

When invited to meet President Coolidge in Washington, the couple set out in a wind of 40 miles per hour, and a temperature of only 20 degrees above zero with no further preparation than putting on warm coats!

The *Moth* has only a 60-horsepower Cirrus engine and is of conventional but clean design, with deep, well-sheltered cockpits, a gravity fuel system (gas tank in the wing) and a big rudder with a large degree of balance.

We cannot resist the temptation of quoting from a De Haviland advertisement: "As simple to run as a small car—an entirely practical vehicle, embodying every comfort for passengers and ample space for luggage, easy controls, and a travel capacity of 70 to 80 miles per hour in any weather;

National Feature Photos

The Richard-Penhoet flying boat to be used on French air lines between southern France and northern Africa. With a span of 131 feet and a weight of over 19 tons, this five-engined craft is one of the largest ever built

Steel Sheets that *Resist Rust!*

THE destructive enemy of sheet metal is *rust.* An alloy of copper gives to Steel Sheets and Tin Plates the highest degree of resistance to rust and corrosion. Keystone Copper Steel gives maximum endurance—a fact proved by actual time and weather tests. For lasting and satisfactory service insist upon

KEYSTONE
Rust-resisting Copper Steel
Sheets
AND ROOFING TIN PLATES

Black Sheets for all Purposes

AUTOMOBILE SHEETS—ELECTRICAL SHEETS
DEEP DRAWING AND STAMPING STOCK
GALVANIZED SHEETS
FORMED ROOFING AND SIDING PRODUCTS
TIN AND TERNE PLATES, ETC.

Keystone Copper Steel gives superior service and rust-resistance for roofing, siding, gutters, spouting, flashings, metal lath, tanks, culverts, flumes, and all uses to which sheet metal is adapted, where resistance to corrosion is an important factor. We manufacture American Bessemer, American Open Hearth, and Keystone Copper Steel Sheets and Tin Plates for every requirement. Sold by leading metal merchants. Write nearest District Sales Office for particular information, and send for booklets.

Sheet Mill Products

Black Sheets for all purposes, Apollo and Apollo-Keystone Copper Steel Galvanized Sheets, Culvert and Tank Stock, Formed Roofing and Siding Products, Special Sheets for Stamping, Automobile Sheets, Electrical Sheets, Stove and Range Sheets, Barrel and Keg Stock, etc.

Tin Mill Products

American Coke and American Charcoal Bright Tin Plates, Taggers Tin, American Old Style and American Numethodd Roofing Terne Plates, MF Roofing Tin Plates, Black Plate for all purposes: Enameling Stock, Stove Pipe and Elbow Stock, Special Stamping Stock, etc.

American Sheet and Tin Plate Company

General Offices: Frick Building, Pittsburgh, Pa.

DISTRICT SALES OFFICES

Chicago Cincinnati Denver Detroit New Orleans New York Philadelphia Pittsburgh St. Louis

Export Representatives: UNITED STATES STEEL PRODUCTS CO., New York City

Pacific Coast Representatives: UNITED STATES STEEL PRODUCTS CO., San Francisco, Los Angeles, Portland, Seattle

TIRE ECONOMY · ACCESSIBILITY · APPEARANCE

White uses DAYTONS

The purchasers of a White Truck expects extraordinary performance—enduring performance—economical performance from his White—and he gets it. White Trucks have attained their high place in a high-grade field by satisfying shrewd buyers. The annual White Roll Call is proof of this.

It is only natural that White should, in turn, demand extraordinary performance—enduring performance—economical performance from equipment. That's why White uses DAYTON STEEL WHEELS.

Nearly all leading truck makers use DAYTONS. Specify them.

Deliveries are timely and steady.

Far Western Distributor
The Kay-Brunner Steel Casting Co. of Los Angeles is the exclusive manufacturer and distributor of Dayton Steel Wheels, west of the Rockies.

The Dayton Steel Foundry Company
Dayton, Ohio

Dayton
The Mark of a Good Wheel

STRENGTH · LIGHT WEIGHT · DURABILITY

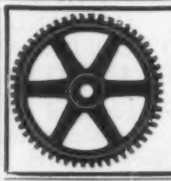
"Why I Sent My Children Away To School"

MOTHERS and fathers everywhere have highly appreciated Mrs. Blair's article, under the above title, which appeared in a recent issue of *Harpers Magazine*. It has enlightened many perplexed parents and helped them to a happy solution of the school problem for their children.

Mrs. Blair's careful study of the needs and ambitions of her own children impelled her to write a straight-forward, revealing article which contains much of interest and value to parents with children of school age.

Our School Bureau will be glad to send you a copy of this article without charge, or any other information you want regarding camps, schools and colleges. Address

Harpers MAGAZINE
49 East 33rd Street, New York, N. Y.



GEARS
All Kinds-Small
The most accurate made and prices reasonable. We carry a complete line of gears in stock for immediate shipment. Can also quote on special gears of all kinds. Send us your inquiries.
Write for Catalogue 20
CHICAGO STOCK GEAR WORKS
105 South Jefferson Street Chicago

Ice Making and Refrigerating Machinery
Corliss & Poppet Valve Engines
Bulletins sent upon request
THE VILTER MFG. CO.
899 Clinton Street Milwaukee, Wis.

LEARN WATCHWORK JEWELRY WORK AND ENGRAVING
A fine trade commanding a good salary and your services always in demand or you can start in business for yourself. At

BRADLEY INSTITUTE
The greatest school for watchmakers in the world. Address Horological Dept. H, Bradley Polytechnic Inst., Peoria, Ill., for our latest catalogue.

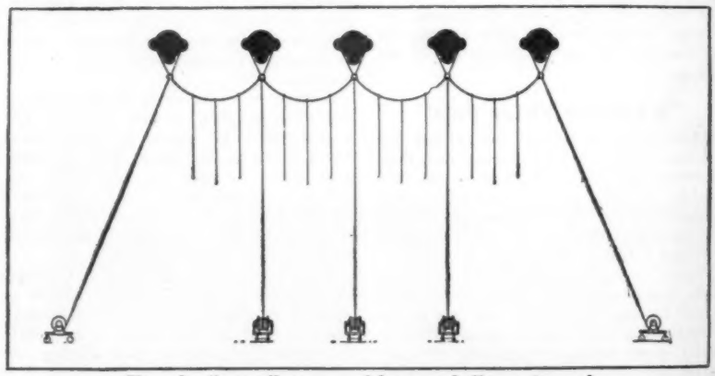
HERE'S MORE MONEY for YOU
150 Home-Study Books
Each of these sure pay raising, self-help books is a complete course of instruction. They cover Electricity, Automobile, Machine Shop, Carpentry, Painting, Engineering, Railroading and twenty other trades. Full catalogue FREE. A postcard brings yours.
F. J. Drake & Co., Publishers
1085 Michigan Avenue, Chicago

Wide World
The De Haviland *Moth* in which Sir Alan Cobham, of Australian flight fame, is doing his traveling in the United States

cheaper to maintain than a car . . . . the *Moth* will fly over 250 miles without refuelling . . . . price, 830 pounds (about 4,000 dollars)." Apparently prices for planes in England actually run much higher than those for similar craft in the United States.

Barrage Balloons

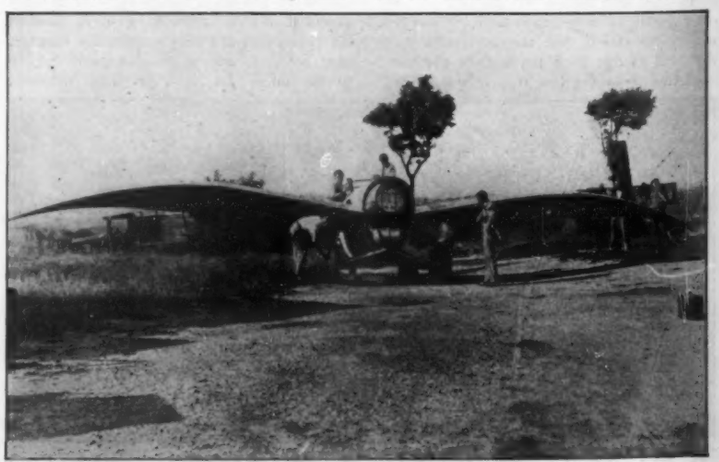
FOR meeting bombing attacks in the daytime, fast airplanes and anti-aircraft artillery give the best protection. At night or in fog, recourse may be had to barrage balloons, particularly where very important objectives are involved. Colonel Chandler, one of the co-authors of "Free and Captive Balloons," gives an interesting description of this system of protection. The "apron" system is particularly effective. In it, captive balloons of fairly large size are used, whose ascensional force is great enough to permit the support of a horizontal wire between balloons and also of the suspension of a few vertical wires from the horizontal connection. At night it is extremely difficult for an airplane to encounter such a barrage without serious difficulties; either the wings are damaged, or the propeller or control surfaces fouled so as to cause a forced landing. The danger to the plane is further increased by the swaying of the balloons. The distance of the winches from the object to be protected depends upon the height to which the balloons ascend.



How the "apron" system of barrage balloons is used

Imitating the Bird's Wing

LEONARD W. BONNEY of Flushing, New York, after many years spent in the study of the wings of sea-gulls has produced the somewhat peculiar looking craft shown in our photograph. The wing is exactly like that of a sea-gull both in its plan form, thickness and front view. It has proved surprisingly efficient in wind tunnel tests, and therefore, the flight tests will be watched with considerable interest.



P. & A. Photos
This type of plane, built after a lengthy study of the wings of birds, has proved to be quite efficient in wind-tunnel tests

Radio Notes

A Review and Commentary on the Progress in This Branch of Rapid Communication

Conducted by Orrin E. Dunlap, Jr.

Short-Wave Units

A NEW unit which will permit the reception of waves from 40 to 200 meters with any type of vacuum-tube receiver has been introduced by the Crosley Radio Corporation. By attaching it to the average set, the 5,000,000 receivers now in use can be utilized for the reception of short waves.

The J-M-P Manufacturing Company of Milwaukee, Wisconsin, is also placing a similar unit on the market under the name of the "submariner," for the same purpose.

Radio "Bloodhounds" Clear Air of Noises

RADIO dealers in Richmond, Virginia, have organized a committee to rid the ether of interfering noises caused by electrical devices, power lines and radiating receivers.

Greenhow Johnston, chairman of the committee, contends that very little interference is caused by atmospheric electricity but that most of the disturbances are "man-made static." He said that most of the strange noises picked up by receiving sets are caused by electrical leaks which can be stopped.

"The telephone company, electric light and power companies and the railways are cooperating to the fullest extent," said Mr. Johnston, "because to find a leak in a line raises the electrical efficiency of the wire. It is just like a leak in a water pipe and that means a loss. We have developed several receiving sets which we call 'bloodhounds' and with these sets we ride about town in an automobile hunting for the disturbance centers. We close in on the noise with a long-range receiver. This circuit picks up all noises so when we get near enough to the source we definitely locate it by means of a 'little bloodhound,' which has a shorter range. This set can be regulated to detect a noise from one-half to thirty feet away.

"Generally we use a loop antenna as the direction finder but in some cases we have found that the disturbance is sprayed in all directions like a fog. Then we substitute a copper tube about six feet long and one-fourth inch in diameter for the loop. The tubing is filled with salt water. One end is connected to the antenna binding post on the receiver and the free end is pointed toward the source of the noise. A portion of the tube is covered with rubber tape in order to provide a handle so that the hand will not come in contact with the tubing."

Mr. Johnston listed the most general sources of radio noises: electric wires grounded by touching and rubbing against trees; spark coils; rusty and corroded joints in electric lines; poor rail binders on electric railways; some battery chargers; vacuum cleaners; electric heating pads; electric lamps not screwed tightly into the sockets; loose connections in power transformers; regenerative receivers; loose connections in the receiving set; poorly designed grid leaks, and, occasionally, defective vacuum tubes.

He pointed out that a good antenna and ground are important. "I use three telephone rods driven into the earth about sixteen feet, and each one is connected with the ground binding-post on the receiver," said Mr. Johnston. "The antenna should be all one piece of wire without any splices. When buying antenna wire, get it long enough to stretch from the far-end support right through to the antenna terminal on the receiver."

The "bloodhound" mentioned consists of one stage of tuned radio-frequency amplification, a detector and two stages of audio-frequency amplification.

Looking for Trouble

IF your radio set becomes "sick" the following diagnosis prescribed by two engineers in an address before the Institute of Radio Engineers may help you to locate the source of trouble.

Light the tubes and tune the receiver to the point where the best local station is received. Note the volume of the loud-speaker. If the volume is weak, tap the tubes with the finger nail to determine whether or not the audio-frequency amplifiers are operating satisfactorily If the amplifier is working satisfactorily a ringing sound will be heard in the loud-speaker. If this ringing sound does not result, check the polarity and voltage of the batteries and replace all defective ones. Inspect the connections of the batteries, and if this does not result in satisfactory reception, try replacing the tubes.

If no sound is audible, immediately replace the loud-speaker with the head phones

Underwood & Underwood

An American motorcycle and radio enthusiast linked his two hobbies together by installing the receiver in the sidecar and stretching the antenna across the top on a special framework as illustrated

NEW!
The Layerbilt patented construction revealed. Each layer is an electrical cell, making automatic contact with its neighbors, and filling all available space inside the battery case.
No486
EVEREADY
RADIO "B" BATTERY
Eveready Layerbilt "B" Battery No. 486, the Heavy-Duty battery that should be specified for all loud-speaker sets.
DIFFERENT!

For greatest economy all loud-speaker sets require the new Eveready Layerbilt "B" Battery

IT WILL pay you, in convenience and reliability as well as in dollars and cents saved, to use this remarkable battery.

The reason for the Eveready Layerbilt's surprising performance lies in its exclusive, patented construction. No other battery is like it. It is built in flat layers of current-producing elements, making practically a solid block. The layers make connection with each other automatically, and occupy all available space inside the battery case. Layer-building packs more active materials in a given area, and makes those materials produce more electricity for a given weight.

Every loud-speaker set should use Heavy-Duty batteries, for they alone offer economy on modern receivers. When you buy new "B" batteries be sure to get the Heavy-Duty size, and remember that the Eveready Layerbilt has proved to be the longest lasting, most economical of all Heavy-Duty batteries.

Our laboratories are continually testing batteries and in all our tests we have yet to find a battery that is equal to the new improved and radically different Eveready Layerbilt "B" Battery No. 486. The development and perfecting of this remarkable battery is an outstanding battery-building achievement. It is the result of many years' experience plus the facilities and resources of the pioneer manufacturers of all dry cell batteries.

NATIONAL CARBON CO., INC.
New York San Francisco
Unit of Union Carbide and Carbon Corporation

Tuesday night is Eveready Hour Night—
9 P. M., Eastern Standard Time

WEAF–*New York* WJAR–*Providence* WEEI–*Boston* WTAG–*Worcester* WFI–*Philadelphia* WGR–*Buffalo* WCAE–*Pittsburgh* WSAI–*Cincinnati* WTAM–*Cleveland* WWJ–*Detroit* WGN–*Chicago* WOC–*Davenport* WCCO (*Minneapolis, St. Paul*) RSD–*St. Louis* WRC–*Washington* WGY–*Schenectady* WHAS–*Louisville* WSB–*Atlanta* WSM–*Nashville*

ANCIENT PORT TAXES were figured on the length and beam of the ship. Merchants, the boat owners of those days, soon saw the advantage of bellying bottoms, giving extra cargo at no greater tax, but they sacrificed speed to illicit quantity. Today in commerce and in industry exactitude of measurement is essential, particularly in matters of temperature

In selling instruments of measurement the obligation is ACCURACY

If you knew exactly which instruments you sold were to be arbiters of life or death—you could sell to those buyers your best, and carry less accurate instruments for others. But you never know when any particular instrument of measurement may become an instrument of destiny.

The instrument you sell today may decide the fate of your community's most valuable citizen tomorrow. On the seller, on the maker of such instruments rests a heavy responsibility. In industry at its critical points; in the sick room while life hangs in the balance; on land, on sea, in the air when accuracy may mean life or death—*Tycos* instruments are meeting their obligations faithfully. The Taylor Instrument Companies make over eight thousand styles of *Tycos* Instruments used in the home, the hospital, the laboratory, in industry, on land and sea and in the air. They answer questions of temperature—accurately.

Taylor Instrument Companies

ROCHESTER, N. Y., U. S. A.

CANADIAN PLANT
TYCOS BUILDING, TORONTO

MANUFACTURING DISTRIBUTORS IN GREAT BRITAIN, SHORT & MASON, LTD., LONDON

Reaching for Higher Ratings

Let machines count their product on Veeder Counters, and every gain in production-rate is a step toward *higher* records. Your machine is developed in just those details which make for a higher *count*. You bring out the best in machine design *and* the best efforts of the operator, by reaching for the production-rating held out by your

Veeder COUNTER

This Small Rotary Ratchet Counter (No. 6) counts reciprocating movements of the lever, as required for recording the output of many small machines. When the lever is moved through an angle of 40 to 60 degrees, the counter registers one. The further the lever is moved, the higher the number registered. A complete revolution of the lever registers ten. This counter can be adapted to no end of counting purposes, by regulating the throw of the lever. Price, $2.00. (*Cut nearly full size.*) Small *Revolution* Counter of similar model, also $2.00.

This large RE-SET ROTARY RATCHET COUNTER records the output of punch presses, metal-stamping machines and others where a reciprocating movement indicates an operation. Registers one for each throw of the lever, and sets back to zero from any figure by turning knob once round. Provided with from four to ten figure-wheels, as required. Price with four figures, as illustrated, $11.50. (List.) Equipped with lock and keys to prevent tampering with the record, $2.00 extra. (*Cut less than half size.*) Set-Back *Revolution* Counter of similar model, $10. (List.)

The Veeder booklet will show you counters to register increased production at ANY machine. Sent free to all who may meet with the problem—in invention, engineering or manufacturing.

The Veeder Mfg. Co., 18 Sargeant St. Hartford, Conn.

to determine whether or not the loudspeaker is defective. If no results are obtained, turn off the "A"-battery switch, remove the tubes and by means of a voltmeter, check the voltage between the filament and the plate contact springs of each socket. If satisfactory indications are had and no signal is heard, repeat with a similar operation between the grid and filament contacts, using a pair of head phones in series with a 22½-volt battery in place of a voltmeter. Rather decided clicks should be heard when contact is made in each instance with the exception of the detector grid. Because of the fact that a high-resistance grid leak is used in the detector circuit, the click will be weak.

The most difficult type of failure to determine and locate is that caused by a high-resistance connection. This will cause the set to operate with unsatisfactory results. This condition is sometimes mistaken as location trouble. A high resistance is possible at any connection in the receiver. Soldered connections that were made by the use of a corrosive flux that has not been properly treated after the soldering operation are probably the worst offenders. Weak mechanical springs in telephone jacks and switches may also introduce high-resistance connections.

Short-wave Data

A STATISTICAL staff at station WGY has completed the tabulation of thousands of reports regarding transmissions on a variety of wavelengths, extending over a period of eighteen months, during which time trained observers in all parts of the world made records of reception.

A small percentage of the total reports dealt with the 15-meter wave transmissions. On this wavelength no reports were received regarding daylight reception within a radius of 900 miles, indicating an apparent skip distance of this magnitude. That is to say, the signals were projected into the sky but were not reflected back to the earth until they had traveled 900 miles. At night the skip distance of the 15-meter waves was 1,000 miles.

About 900 observations were made on the 26.38-meter transmission. These indicated a day skip of 100 miles, which at night increased to 450 miles. These limits, however, are not sharply defined, varying considerably from day to day. Although the signal characteristics beyond the limits of the day and night skips were not as erratic as those on 15 meters, the reliability was low at a distance of 3,000 miles. Beyond the region of uncertainty, the signal became more reliable and consistent.

It was noted that at 2,650 miles the night signal-audibility is low, which might lead to the erroneous conclusion that the useful range was not greater than 3,000 miles,

Underwood & Underwood

This new direction finder has been developed by the engineers of the Bureau of Standards to cover wavelengths from 39 to 3,300 meters

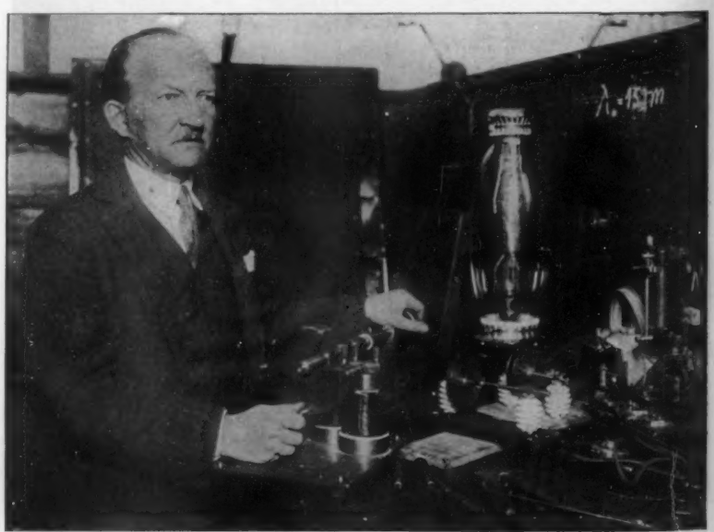
according to engineers. As a matter of fact, reports from observers in New Zealand and Australia indicated better reception than that at most points in the United States.

More than 5,000 reports were received regarding the 32.77-meter transmission. Analysis showed the day skip-distance to be 100 miles on this wave. This distance increased at night to 400 miles.

The limit of the day range for this transmission could not be established definitely, due to insufficient reports beyond 2,650 miles. Reports on the night transmission were received from all parts of the world, indicating a fairly consistent high average strength for the maximum distance obtainable, that is, one-half of the earth's circumference.

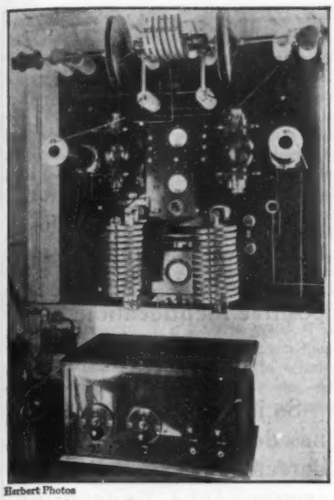
The day and night audibility characteristics of 50.2-meter transmissions indicated that no skip distance existed at this frequency. The useful day range of this transmission was definitely shown to be 1,100 miles. The curve of night audibility indicates that at 2,650 miles the signal strength was still good. The analysis showed that reports from distances greater than 2,100 miles were so erratic as to make it impossible to determine the absolute useful limit of the night transmission.

The attenuation of the day signal of 65.5-meter transmission was not great. At 1,050 miles the strength was fairly high, indicating that satisfactory reception might be had for 200 or 300 miles further. Actually this was not true, because fading, static and other factors which prove detrimental to



Underwood & Underwood

Dr. Graf Von Arco, German radio experimenter, in his research laboratory. Note the German tube, and how it differs from standard American tubes



Herbert Photos

Records in short-wave transmission and reception have been established by means of this apparatus on board the Australian ship *Jervis Bay*. Constant communication was maintained with Australia on a trip from London to Sydney. The wavelength used was 34 meters and the power, one-half kilowatts

good reception, caused the signal to become unreliable at points further than 1,000 miles from the transmitter. The night audibility-curve shows only slight attenuation at all distances to 2,650 miles. Again, erratic reports make it impossible to accurately fix the limit of the night range. Accordingly, the region beyond 1,600 miles must be considered as an unreliable zone.

The 109-meter waves behaved more in conformity with those of the broadcast and commercial channels than did any of the other frequencies used during the test. Day and night audibilities were quite rapidly attenuated, the former reaching a lower useful limit at 400 miles, while the latter was sufficient to furnish a satisfactory signal for 1,000 miles.

Trapping Waves

THE reception of time signals from station NAA at Arlington for rebroadcast on KDKA's 309-meter wave entails an elaborate trapping and shielding system. The receiving set is located about 100 feet from the transmitting station and utilizes two sets of antennas—long and short wave. In order to tune in station NAA, a wavetrap for each wave band is installed before the receiving set. Outside wires are sheathed in lead cable and the apparatus is shielded by metallic screens. A covered cable carries the signals to KDKA's transmitter.

Amateur Prefixes

SHORT-WAVE amateur stations throughout the world use a prefix of one or two letters to designate the country in which they are located. For example, "U" before a call signifies that the station is in the United States, such as "U-8LQ."

The list of prefixes follows:

A—Australia	I—Italy
AU—Alaska	IC—Indo China
B—Belgium	J—Japan
BE—Bermuda	JM—Jamaica, West Indies
BN—Borneo	K—Germany
BZ—Brazil	L—Luxemburg
C—Canada	M—Mexico
CH—Chile	N—Netherlands
CR—Costa Rica	O—South Africa
CS—Czecho-Slovakia	P—Portugal
D—Denmark	PE—Palestine
E—Spain	PR—Porto Rico
F—France	R—Argentina
FI—French Indo-China	S—Scandinavia
FM—Morocco	SS—Straits Settlements
G—Great Britain	TTS—French Africa
GH—Ecuador	U—United States
GW—Ireland	VC—India
GX—Ireland	Z—New Zealand
H—Switzerland	
HU—Hawaii	

Antipodes a Goal

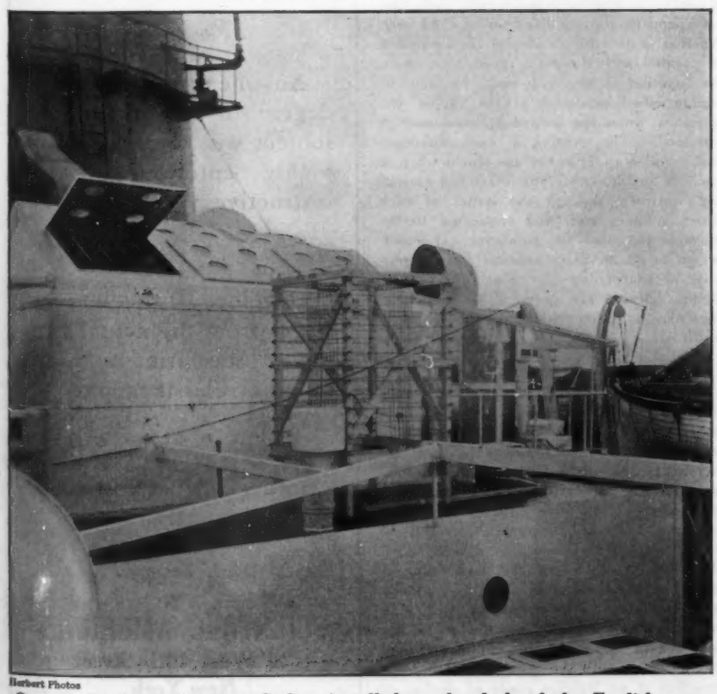
JAPANESE and Australian broadcasters offer a new goal for listeners who are striving for long-distance records. Station JOAK, Tokio Broadcasting Bureau, is rated at 1,500 watts. It signs off about 3 A.M., Eastern Standard Time. The Japanese stations are confined to waves between 360 and 385 meters.

Listeners on the Pacific Coast report reception of station 3LO, Melbourne, Australia, on 371 meters, also 7ZL, at Hobart, on 390 meters. These stations are generally heard early Sunday mornings between 2 and 5 o'clock, Eastern Standard Time.

After the majority of California stations sign off for the night, KGU, Hawaii, can often be heard on 270 meters. The power rating is 500 watts.

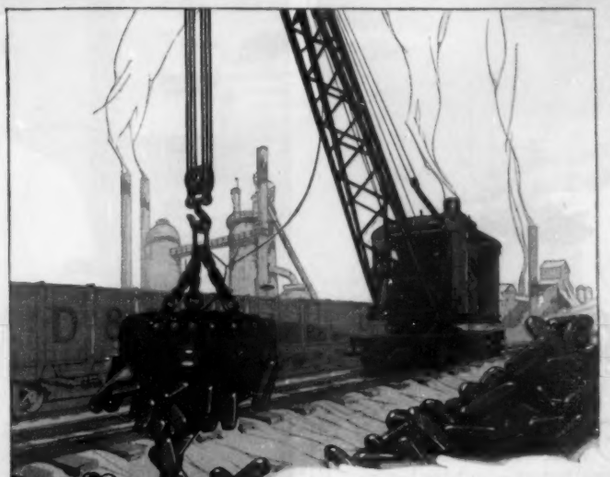
To Move NAA Radiophone

IN an effort to minimize interference among broadcast listeners, the radio-telephone unit of NAA will be moved from



Herbert Photos

One of the latest direction finders installed on the deck of the English merchantship, *Asturias*. The apparatus is often called the "silent sentinel"



Magnetism and Yellow Strand

It's magnetism that holds the pig iron to the business end of this powerful crane, but—

It's Yellow Strand Wire Rope that lifts the load and proves its economy by long, faithful service.

Yellow Strand is *made* for heavy duty and makes its best showing under unusually severe conditions—where great strength must be combined with enough elasticity and flexibility to stand the gaff.

For real, economical service, specify Yellow Strand in your next wire rope requisition and look for the *strand of yellow*. It's your protection.

This company also makes all standard grades of wire rope for all purposes.

Motorists

Carry a Basline Autowline in your car and safeguard your spare tire with Powersteel Autowlock. Both are made of Yellow Strand. Ask your accessory dealer.

BRODERICK & BASCOM ROPE CO.
805 North First Street, St. Louis, Mo.
Eastern Office and Warehouse: 68-70-72 Washington St., New York City
Western Office: Seattle *Factories:* St. Louis and Seattle
Authorized Dealers in all Industrial Localities

Yellow Strand WIRE ROPE

CAMERA CRAFT
A Monthly Photographic Magazine covers all phases of photography, is practical, interesting and beautiful.
15 Cents the Copy $1.50 by the Year
Sample copy on request
Camera Craft Publishing Company
703 Market Street - San Francisco, Cal.

"WONDER" Cold Pipe and Tubing Benders Do Not Crack, Flatten or Crimp the Pipe
Standard of the World
Hand and Motor Operated
14 Sizes of Machines
What it costs to bend pipe our way, per bend:
1-inch pipe . . . . . 5 cts
2-inch pipe . . . . . 10 cts
4-inch pipe . . . . . 25 cts
6-inch pipe . . . . . 50 cts
8-inch pipe $1.00
Send for Catalogue
American Pipe Bending Machine Co.
32 Pearl St. Boston, Mass.

CHARGE BATTERIES!
Make money rapidly! You can do it with the *slave* for work, the *new* Model "BT"
SCIOTO BATTERY CHARGER
Complete with bulb. Current cannot backflow. Charges 2 to 17 batteries at a time. 25-60 Cycle, 110 Volts A.C. or D.C.
$50
10 percent additional charge west of Rockies. From your Jobber or Order Direct.
All contact points enclosed for safety in *woven cane design* metal casing. Only ammeter, switch and dial control handle exposed on polished aluminum face.
THE ADAMS-BARRE CO.
Fifth and King Ave. Columbus, Ohio

Universal
10 to 50 H.P.
Marine Motors
Again Universal forges ahead! New 1927 world-famous Flexifour 10-15 H. P. Marine Motor now much sturdier, with greater power, yet lighter and more compact. Overall length reduced 5 inches. Only one place to oil. Gives same thrilling performance to a launch as displayed by the latest model cars. New improved, oil and water tight reverse gear with positive neutral. *Send for* FREE *catalog.*
Mention size and type of your boat.
UNIVERSAL MOTOR COMPANY, Oshkosh, Wis.
47 Ceape Street
New 1927 Flexifour

ASK . . ANY . . RADIO . . ENGINEER

The Crowning Adventure of Burgess Radio Batteries

They Flew Over the North Pole with Byrd

ON May 9, 1926, history was made—American history—World history—undying history.

Lieut. Commander Byrd, in his fearless 1500-mile flight across the top of the world, adds another thrilling triumph to the long, proud list of American achievements.

Radio went along, for radio has become vital to the lives and success of explorers and adventurers. Burgess Batteries went along, sharing the fate—sharing the hardships and the glory of Commander Byrd, the Detroit Artic Expedition, and Capt. Donald MacMillan.

It is eminently significant that in these glorious triumphs of American courage and American equipment where the test of men and their tools was the test of the survival of the fittest, that the standard products of the Burgess Battery Company were selected, used and "carried on" under extreme and unprecedented conditions.

BURGESS BATTERY COMPANY
GENERAL SALES OFFICES: CHICAGO
Canadian Factories and Offices: Niagara Falls and Winnipeg

BURGESS RADIO BATTERIES

Solvents for your problems

Butanol (Normal butyl alcohol) basic material for many valuable compounds. Essential ingredient in modern lacquers.

Acetone, C. P. the universal solvent.

These and other C. S. C. solvents, available in any quantity and at attractive prices, are rich in opportunities for the alert investigator.

Interesting descriptive pamphlet on request

Commercial Solvents Corporation
1400 First Street Terre Haute, Ind.

Herbert Photos

The current-supply devices for the filament and plate circuits of this five-tube power set are located at the ends of the base. The set operates entirely from the alternating-current house-lighting circuit

Arlington, Virginia, to the navy yard in the southwest section of Washington. The transmitter will continue to operate on 435 meters and will broadcast weather reports, time signals, agricultural information and Government reports.

Moscow Signs Off with Carillon

Moscow now has a broadcasting station operating on the 1,450 meter wavelength and using the call letters RDW. The power output is rated at 12 kilowatts.

The waves of this station are said to reach the British ether, making difficult the reception of code signals in the vicinity of 1,450 meters. At the same time English broadcast listeners say that the German transmitter at Konigswursterhaven blankets the talks and music from RDW, although the stations work on different wavelengths.

Moscow usually signs off about 10 P.M. with the pealing of the Internationale on the Kremlin carillon.

New Yorker Picks Up 436 Broadcasters

MANHATTAN ISLAND, despite its many steel buildings, is not so bad for long-distance radio reception, according to William A. Snead of 179th Street, who reports that he has logged 436 different broadcasting stations.

He said: "To date I have 368 verification stamps and quite a number due. About twenty stations do not issue stamps. Those from distant points include: California, 10; Oregon, 1; New Mexico, 1; Wisconsin, 14; Texas, 11; Canada, 15; Cuba, 1; Porto Rico, 1 and Mexico, 2. Of 44 received from Illinois, 28 are from Chicago. My location is in the heart of New York City, among the 'cliff dwellers,' with about 15 aerials on the roof and thousands within a small area, most of them emitting squeals and howls. Within the metropolitan district there are 47 stations, most of them broadcasting each night, and they form a barrage that requires considerable manipulation of the dials to get through their waves; in fact, some of the stations are so powerful they blanket about 15 degrees on the dials. I have logged 436 stations.

"It would appear that those living remote from the great centers of broadcasting should have a collection greatly exceeding this one of mine."

New Direction Finder

THE rapid increase in the range of wavelengths used for radio transmission purposes has created the need for a direction finder which will function over a wide band of frequencies and yet be portable and simple to operate. To meet this requirement such a finder has been developed by F. W. Dunmore of the Bureau of Standards, which operates over the band from 3,300 to 39 meters.

In Mr. Dunmore's finder, a shielding aluminum box contains all the receiving apparatus, including batteries, with the exception of the direction-finder coil which is supported on a bakelite shaft extending through the box and rotated by means of a hand-wheel under the box.

The direction finder is of the simple rotating type. Automatic features are provided so that only a single tuning and a single balancing control are used. The receiving set is a super-heterodyne which employs a standard Signal Corps amplifier. The controls are reduced to a single one by mounting the main tuning condenser and the heterodyne-generation tuning condenser on the same shaft. The latter condenser has connected in parallel with it an auxiliary condenser of slightly smaller capacity operated by means of a cam which may be slipped on the shaft carrying the two tuning condensers.

The wide wavelength range is made possible by a set of seven interchangeable plug-in direction-finder coils, each with a corresponding heterodyne generator coil and a cam for operating the auxiliary tuning-condenser. Another automatic condenser is connected in parallel with the main tuning condenser. Its function is to compensate for the detuning effect produced at the higher frequencies when the balancing condenser is operated. The center of each direction-finder coil is grounded to the shield when in use. A small, telescoping brass rod extending vertically through the center of each direction-finder coil, and connected to the movable plates of the balancing condenser, serves as an auxiliary antenna for the purpose of sharpening the point of minimum signal. Means are provided so that bearings may be taken with respect to magnetic north.

"B" Eliminators

BASED upon a survey of "B" eliminators, the American Mechanical Laboratories have issued a list of suggestions for operation, trouble shooting and remedies in these devices. It is pointed out that a "B" eliminator must be properly designed and constructed if it is to give satisfactory service, especially over a considerable period of time. Engineers explain that a really good eliminator is costly, for the reason that it incorporates a powerful transformer, choke coils, condensers, and resistances. As with everything else, one gets precisely what one pays for in buying a "B" eliminator; and trouble starts with the purchase or the construction of an inferior grade of device.

"'B' eliminators," says the report, "are now made in the standard and heavy-duty

FINGERPRINTING IN INDUSTRY

A number of large industries have adopted fingerprinting as a means of positive identification.

❖ ❖ ❖

So its scope of usefulness has developed beyond the detecting of criminals. In consequence fingerprint experts are much in demand in Industry, as well as among Peace Officers.

❖ ❖ ❖

One of the best known American authorities on the subject is FREDERICK KUHNE, formerly a member of the New York Police Department. His book—

THE FINGERPRINT INSTRUCTOR

is the recognized text-book on fingerprinting.

❖ ❖ ❖

Anyone with the slightest degree of interest in the subject will find the book highly entertaining and instructive.

❖ ❖ ❖

Develops through easy stages from the actual taking of the print to their scientific classification.

❖ ❖ ❖

In a word "It will make you an expert."

$3.15 postpaid

SCIENTIFIC AMERICAN
24 West 40th Street
New York

models, the former proving quite satisfactory for the usual run of receivers, while the latter is intended for receivers employing the power tubes. It is unfair to expect heavy-duty service from a small eliminator.

"In building a home-made 'B' eliminator, none but the best components should be employed. It is good practice to buy a kit of parts, rather than scattered units, in order to have the benefit of skilled engineering and research. Here, again, it is well to remember that good products cost more money but insure reliability and lasting satisfaction.

"Any make of good 'B' eliminator should operate the usual receiving set silently and with just as satisfactory volume as the 'B' battery. However, if a hum is detected in the reception, it may be due to mechanical vibration from the eliminator, or to electromagnetic induction. In either event, the eliminator should then be placed at some distance from the receiver."

Farm Programs Planned Along Specified Lines

THE technique of preparing material for radio broadcasting is one of the fine points in winning and holding the appreciation of radio audiences, according to Sam Pickard, chief of the radio service, United States Department of Agriculture.

"Certain rules must be observed by the radio writers in preparing the material to be broadcast," said Mr. Pickard.

"The subject matter must have 'teeth' in it—real punch in the form of fresh, new, helpful information. The program maker dare not bore his audience with restatement of old facts. He must sense the questions his audience may be asking, and without waste of words or attempt at oratory.

"Information must be clearly and interestingly presented. Every fact must be dramatized to the fullest extent—be prepared with a friendly tone and ring true when spoken. All scientific terms and words are eliminated.

"The radio program maker edits both with his ears and eyes to determine whether the copy 'speaks smoothly.' He reads it aloud to test its 'ear quality,' for words and sentences easily read may sound awkward when spoken. Difficult consonants are avoided. Construction is simplified. It is the listener's ear, not his eye, that must be made to register. He must be made to feel that he is being 'talked to' or 'visited with,' rather than 'lectured at.' Dignity in the program is essential. Cleverness must be genuine.

"But all these efforts are of no avail," concludes Mr. Pickard, "unless the voice at the microphone is pleasant, friendly and effective. The microphone artist must show genuine interest in his audience and subject matter."

Commenting further on educational programs, he said that the best time of day for such features is a matter on which opinions differ. The Department of Agriculture prefers the noon hour, preferably 12:30 to 1, for farm programs. The second best time is early evening—from 6:30 to 7:30. The later evening hours, he believes, should be reserved for music. Evening is the time for folks to enjoy themselves with entertainment and forget working-day problems.

2LO's Echo Room

ENGINEERS at station 2LO, London, have built a special room which they call the "echo room." It has no draperies nor any objects likely to act as impediments to the natural echo.

A loudspeaker designed to give as perfect reproduction as possible is located in this room and a microphone re-collects the transmission, which is conducted back to the control room to join the original output from the studio.

The artificial echo is imposed on dance music, orchestral work, octets, ballad concerts and opera, but never on speech. It is possible to produce almost any desired effect by changing the number or positions of the amplifiers and microphones.

Signals Strong at Antipodes

HERTZIAN waves travel best over that section of the globe which is in darkness. If the receiver is in the daytime half of the earth near the boundary between day and night, it has been estimated that the signals travel through the darkened hemisphere rather than over the shorter route in which daylight prevails. Signals are stronger at the antipodes than at intermediate points, probably because of a meeting of the signals from many paths. There are certain wavelengths on which it is possible to receive at the antipodes throughout the 24 hours.

Herbert Photos

Radio research engineers at the Hartley Laboratory, Columbia University, New York City, testing various types of reproducers in a search for the perfect loudspeaker. It was in this laboratory that Major Edwin H. Armstrong worked when he developed the early regenerative vacuum-tube circuits

Better Power For Your Entire Production

FOR your full line—trucks, busses, tractors or industrial machinery—Wisconsin has the right motors, Sixes or Fours, 20 to 120 H.P., to give each type *better* power.

✦ ✦ ✦

With their specialized overhead-valve design, their close tolerance construction, these great motors yield, consistently, "More Power per Cubic Inch," and show, invariably, increased economy of fuel and oil, more work between overhauls, less lay-up time.

✦ ✦ ✦

We will be glad to supply any interested executive with the facts of performance and economy—*proved* for manufacturer, dealer and operator.

Wisconsin Motors are manufactured in a full line of Sixes and Fours, with power range from 20 to 120 H.P. for trucks, busses, tractors and construction machinery.

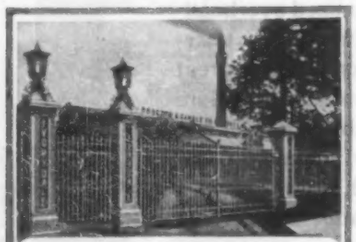
WISCONSIN MOTOR MFG. CO.
MILWAUKEE WISCONSIN

Wisconsin
CONSISTENT

AN OPPORTUNITY

THE Kokomo Brass Works, an industrial concern of thirty years' experience and of the highest standing, wishes to consider articles to manufacture in brass, iron or any other metals. We are particularly interested in specialties of various kinds. Will consider manufacturing on royalty basis or outright purchase. Of course, only articles of merit will be considered. We also solicit your inquiries on articles to be manufactured on a contract basis.

THE KOKOMO BRASS WORKS
KOKOMO Department S INDIANA



Which Is Best?

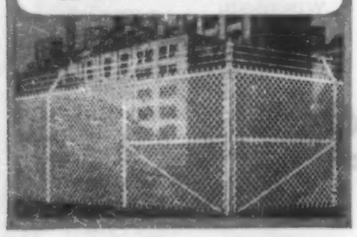
To buy a substantial Stewart Fence, get the benefit of its guarding protection in preventing petty theft and other depredations about your factory, or pay as much or more through losses and still have nothing for your outlay, except a continuance of this annoyance and expense.

Stewarts IRON AND WIRE FENCE

Wide choice of designs of Iron Fence or Chainlink Fence galvanized after weaving, allows the selection of just what suits your needs.

Let us quote you on your requirements.

THE STEWART IRON WORKS COMPANY
Incorporated
241 Stewart Block, Cincinnati, Ohio
"The World's Greatest Iron Fence Builders"



Experimental Station Uses Call 2XN

A NEW experimental radio station for the development of broadcasting apparatus has been built at Whippany, New Jersey, twenty-five miles from New York, by the Bell Telephone Laboratories, Inc., using the call letters 2XN.

The first development work will be in connection with transmission tests on a 50-kilowatt installation now in the course of construction. Tests will be made after midnight so that the station will not interfere.

Two 250-foot steel towers will support the antenna system. The masts are set well out in front so that the building will be away from the denser portion of the field of the antenna. In addition to the tests on broadcasting apparatus, a study will be made concerning transmitting systems for use in broadcasting. There is a shortage of detailed design information on this subject, and further tests are expected to produce worthwhile results.

Other important problems that arise from time to time regarding broadcasting will be taken into consideration and their solutions effected if possible.

The Heavens in March

By Prof. Henry Norris Russell, Ph.D.

At 11 o'clock: Mar. 8
At 10½ o'clock: Mar. 16
At 10 o'clock: Mar. 23

At 9 o'clock: April 7
At 8½ o'clock: April 14
At 8 o'clock: April 22

At 9½ o'clock: Mar. 29

NIGHT SKY: MARCH AND APRIL

The Heavens

IN our view of the stars this month we find Leo high in the south, as our map shows. The Great Bear is just to the north, but beyond the zenith, so that one must turn about-face to see it well. Below it, further northward, are the Little Bear and the Dragon, with Cassiopeia and Cepheus low down on the horizon.

The western sky is brilliant, with Taurus, Orion, and Canis Major low down, and Auriga, Gemini and Canis Minor higher up. Mars, which is in Taurus, adds to the display.

The region in the south below Leo is dull, although Hydra stretches its great length across it. Virgo and Bootes brighten the east, and Corona and Hercules are in the northeast.

The Planets

Mercury is an evening star when the month begins, and should be easily seen, as it sets an hour and a half later than the sun. He is, however, swinging rapidly along his orbit into line between us and the sun, and, on the 13th he passes through conjunction (well north of the sun in the sky) and becomes a morning star. By the end of the month he rises an hour before sunrise, and is again visible.

Venus, too, is an evening star, but remains so all through the month, and grows brighter and brighter. On the 31st she remains in sight until nearly 10 P.M. and is very conspicuous.

Mars has lost almost all of his glory, and shines only as a star of the first magnitude, rather fainter than Aldebaran. It will be easy to compare the brightness of the two, for the planet is in Taurus, and passes north of the star at a distance of about 7 degrees on the 12th.

Jupiter is in conjunction with the sun on the 1st and is invisible, except as a morning star at the end of the month. Saturn is past his western quadrature, but is far south and rises about midnight. He is in Scorpio, and is almost exactly north of Antares, at a distance of a little less than 7 degrees on the 18th, just at the time when he is apparently stationary in the sky, before he begins his retrograde arc toward opposition. Uranus is in conjunction with the sun on the 15th, and is quite invisible. Neptune is in Leo, just past opposition and well observable.

The moon is new at 2 P.M. on the 3rd, in her first quarter at 6 A.M. on the 10th, full at 5 A.M. on the 18th, and in her last quarter at 7 A.M. on the 26th. She is nearest the earth on the 4th and farthest away on the 18th. During the month she is in conjunction with Jupiter on the 3rd, Mercury and Uranus on the 4th, Venus on the 5th, Mars on the 9th, Neptune on the 15th, Saturn on the 24th and with Mercury and Jupiter again on the 31st.

The conjunction with Saturn is close and an occultation of the planet will be visible in South America.

The Origin *of* Reflecting Telescopes

We have to thank Sir Isaac Newton of gravitation fame for our first reflecting telescope. There has been much discussion as to whom credit is due for our refractory telescopes, but the records are quite clear as to the origin of the reflector. Sir Isaac constructed his first instrument in 1666.

It is indeed peculiar that an instrument dating back to 1666 is so little known except among those intimately interested in Astronomy. We venture to state that if you asked the first ten men you met on the street what a reflecting telescope was you would get an evasive answer. If it were explained to these same ten men just what a reflecting telescope is and how cheaply any amateur could build one, we wonder how many of the ten would not soon be testing their skill.

To the average man the heavenly bodies are mere vagaries; he knows they exist, having been taught as much. If a man tells you he has a good horse that he will sell, right away you say "let me see the horse." But if your instructor tells you a long story about Mars, Saturn, or any of the other heavenly bodies, you ask no questions. There isn't the slightest doubt that he is right, but why not apply the rule of the horse?

We admit there is a possible reason for this attitude, for up to now there has been nothing that would tell the amateur how he could build a telescope, and even if he had the ingenuity to do this on his own initiative, he was unable to get the proper material, not knowing the sources.

These questions have been recurring from time to time with the Editors of the Scientific American. They finally came to the conclusion that the subject was something that should go on record. The fancy became a fact with the appearance of Amateur Telescope Making. We can now offer

Amateur Telescope Making

at $2.00 postpaid domestic or $2.15 postpaid foreign

A set of STAR MAPS covering the year with each book.

SCIENTIFIC AMERICAN
24 West 40th Street
New York

Science or Pseudo-Science?

Last year the well-known Hindoo writer, Sir Jagadis Bose, published a semi-popular work entitled "The Nervous Mechanism of Plants." Sir Jagadis has long been known as a lecturer in botany and has visited America in this capacity on several occasions. To plants he ascribes feelings, sensations and other qualities which have already been eagerly seized upon and elaborated by sentimental "old ladies" of both sexes and by pseudo-scientists who obviously prefer sensationalism to scientific accuracy. Sunday supplements of metropolitan newspapers, magazines with leanings toward the occult and certain foreign scientific publications alike have "fallen" for this sort of thing.

When confronted, they answer that reputable scientists have given approval to the opinions of the Hindoo writer. This is true, but it is not the whole truth: science in the twentieth century has become so utterly ramified and so immense in scope that in the average case, a physicist, a chemist or an astronomer is little better fitted to assess the worth of intricate research work in botany than is a non-scientist, and they should not do so publicly. Those who accept Bose's theories should not omit to consult a *botanist*, for the subject involved is botany. Botanists do not agree with Bose.

Dr. D. T. MacDougal, Director of the Desert and Coastal Laboratories of the Carnegie Institution, and Corresponding Editor of the Scientific American, and his assistant, J. B. Overton, have issued the following statement concerning the work of the romantic Hindoo philosopher:

An examination of the assertions of Sir J. C. Bose that sap is pumped upward by the pulsating action of living cortical cells has been made. Bose's claims as to the rate and mechanism of sap movements ignore well-established anatomical and mechanical facts, and are based upon imagined but impossible hydrostatic action of living cells. No single direct observation nor any measure of pulsatory action has even been made by Bose, yet his explanation of the ascent of sap is based on such an idea.

It seems to be plainly evident to most beginners in botany that the drop of water applied to one smoothed end of a saturated branch is not identical with the drop appearing at the other end almost instantly, or that when water under pressure is turned into a hundred feet of filled garden hose, the instantly resulting stream from the nozzle is not made up of water that had traversed this distance in a second, yet Bose's estimates of sap flow are based on ridiculous assumptions that the erection of flagging leaves is due to water passing from the base of stems to these organs at rates as high as 70 millimeters (2¾ inches) per second or as much as 70 meters per hour. (See Bose, "The Physiology of the Ascent of Sap," 1923.)

Bose's conclusions that the wood serves as a reservoir from which living cells draw water and pump it by pulsating action—not through the wood, but from protoplast to protoplast at the rates given, would imply transfer through two to four hundred cells per second and is too fantastic to be the subject of serious comment.

To ascribe rhythmic variations in galvanometer readings connected with electric probes pushed into cortical layers as due to hydrostatic pulsations is to throw aside all of the safeguards of research. When Bose's suggestion that these pulsations may be the result of stimulation by friction of the roots with soil particles it is realized that the passage from pseudo-research to infantile fancies is any easy one.

A sympathetic exposition of the Bose Institute in Calcutta, India, and of the work of its director, reprinted in *The Garland* for May, 1926, (edited by the Palace Tutor Udyar Kralayam), includes the following passage: "For the mysteries of Nature are probed in Sir Jagadis's institute not by study of libraries or by mechanical experiments, but primarily by communion with the unseen and the unknown. Inspiration, imagination, intuition, vision, this is an even more romantic touch."

The correctness of this characterization is attested by every page of Bose's book on the ascent of sap, which is utterly lacking in scientific significance. Such books appearing on the lists of scientific publications constitute a menace and danger to sound science.

Since the acceptance of Bose's work in America has been widely proclaimed in the popular press of Great Britain, we are led to say that such recognition of Bose's work on the ascent of sap and the nervous mechanism of plants has been confined to palace tutors, prime ministers, political propagandists and literary reviewers whose capacity for judgment, motives and purposes may not be adequately discussed here.

Texan Makes Telescope

A reflecting telescope having axes made from Ford motorcar axles, as described in the Scientific American book, "Amateur Telescope Making," has been completed by Mr. C. A. Howard of the Dallas Astronomical Society, 3120 Princeton Avenue, Dallas, Texas. Mr. Howard sends us the following description of his instrument:

Among the essentials of an efficient telescope is the rigidity of the working parts in relation to one another. In the mounting of this instrument of 12¼ inches clear aperture and 100 inches focal length, this feature was carefully considered. The pedestal rests on a concrete base, one cubic yard of gravel being used in its construction.

On top of the pedestal a two-inch wide-pattern return pipe-bend, is mounted. This is held in place by means of the metal straps of a two-inch pipe saddle. On either end of the return bend there is a two-inch pipe tee, whose threads have been milled out to receive the polar axis. This was tightened in position with set screws. By loosening the straps, the return bend can be elevated to any angle desired, according to latitude.

Motion in azimuth may be obtained

Non-Skid Hi-Type
Solves Heavy Trucking Problems

To protect heavy, valuable cargos; to place more rubber, more cushioning under trucks; to provide tires that take hold on wet, oily, slippery pavements, in dirt, mud, sand; to be prepared for long, steady hauls; to make sure ahead of time that your tire costs will be low—equip your trucks with Firestone Non-Skid Hi-Type Tires. Phone your local Firestone Dealer today. He is ready to render immediate service on tires for every kind of hauling.

MOST MILES PER DOLLAR

Firestone
TRUCK TIRES

AMERICANS SHOULD PRODUCE THEIR OWN RUBBER . Harvey S. Firestone

The Midget "Five-in-One" Slide Rule
is a combination Mannheim, Polymetric, Log Log, Binary, Add and Subtract Slide Rule. It will instantly add, subtract, multiply and divide any combination of whole numbers, fractions, mixed numbers and decimals. Gives every root and power, also Logs, Sines and Tangents. Made of aluminum with Engine-Divided scales on white celluloid. Size 4 in. Approved and adopted by colleges. Price with instructions, $1.50. Pocket Case 50c extra. Cash or C. O. D. Catalogue Free.
(Patented 1-17-22)
GILSON SLIDE RULE CO., Niles, Mich.

CHEMISTS
OUR NEW CATALOG OF
Laboratory Apparatus and Chemicals
(1000 illustrations) containing a complete line, is now ready for distribution. Sent on receipt of 25c. RADIO CATALOG, (100 pages) liberal discounts, 10c.
LABORATORY MATERIALS COMPANY
637 East 71st Street Chicago, U. S. A.

$19.50
SPRINGFIELD RIFLE, Model 1903
assembled and refinished
Offered without bayonet. Price $19.50. Packing charge 50c extra. Used gun sling 50c. Ball catridges $3.50 per 100. **New 1927 illustrated catalog,** 280 pages, showing all American guns and pistols since 1775, with other Army and Navy equipment, mailed 50c. Special new circular for 2c stamp. Est. 1865.
Francis Bannerman Sons, 501 B'way, N. Y. City

PATENTS
TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.
PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMER. BLDG. 24-26 West 40th St., N. Y. C.
SCIENTIFIC AMER. BLDG. - Washington, D. C.
TOWER BUILDING - - - Chicago, Ill.
HOBART BUILDING - - San Francisco, Cal.
VAN NUYS BUILDING - Los Angeles, Cal.

Books and Information on Patents and Trade-Marks by Request.
Associates in All Foreign Countries.

Rub in Absorbine, Jr.

Changing weather often brings muscular or rheumatic pains. Absorbine, Jr. will give prompt relief.

Always keep Absorbine, Jr. handy—it is a dependable "first aid". Read "Timely Suggestions", packed with each bottle.

Send for free trial bottle
W. F. YOUNG, Inc. Springfield, Mass.

Absorbine Jr
THE ANTISEPTIC LINIMENT

HOTEL
FORT SHELBY
Lafayette Blvd. at First St.
DETROIT

Less than 5 minutes walk from wholesale, retail, financial and theatrical centers

The seasoned traveler thinks always of the Fort Shelby in connection with Detroit. He knows that there he can be sure of a quiet, comfortable room at a reasonable price, of sincere courtesy, of widely-famed food at moderate cost. The Fort Shelby has the only Servidor equipment in Detroit. This feature protects you from needless intrusion of employes and excessive tipping. Rail and water terminals are convenient.

Rates $2.50 up. Servidor service. Fort Shelby Garage close by.

W. G. McKAY, Assistant Secretary

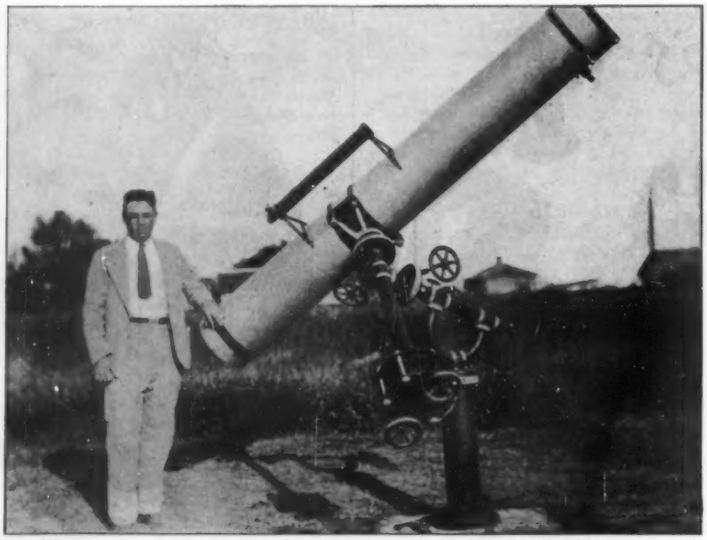
FOR MEN OF BRAINS
Cortez CIGARS
—MADE AT KEY WEST—

STEEL STAMPS
METAL CHECKS
STENCILS
SEALS
SEND FOR CATALOG
THE SCHWERDTLE STAMP CO.
BRIDGEPORT, CONN.

UNIQUE THIN LEAD COLORED PENCIL
Makes fine lines for
Figuring
Checking
Underscoring
Blueprints, etc.
Useful to everyone
$1.00 per doz.
12 Colors

Blue	Purple	Pink
Red	Brown	Lt. Blue
Green	Orange	Lt. Green
White	Yellow	Maroon

At dealers or write direct
American Pencil Co., 217 Fifth Ave., N.Y.
Makers of the famous VENUS Pencils



Mr. Howard's twelve-inch reflecting telescope. The hand-wheels facilitate smooth motions of the various parts

by applying a pair of six-inch pipe tongs to the pedestal and turning it to the desired point. This is only for purposes of initial adjustment.

The declination and polar axes were made from the axles and housings of a Ford automobile. There is no slow-motion gearing, but the brake drums with brakes enclosed can be used with such a degree of nicety that a handle placed on the tube near the eye-piece enables the observer to move the instrument with ease. The necessary friction is applied to the brake shoes with the aid of hand-wheels, as shown in the accompanying illustration. These wheels proved to be much better than thumb-screws. The large hand-wheel on the lower end of the polar axis is used as a quick setting device.

Instead of making a cradle for the tube of the telescope, a two by twelve-inch standard pipe saddle was used. The two wide straps hold the tube with the utmost precision and rigidity.

The counterbalance was made from a ten-inch dresser pipe-coupling, on either side of which a disk of one-eighth-inch sheet iron is bolted. This element is very heavy itself and since it is hollow, lead was poured in to make the necessary balance complete. A two and one-half-inch floor flange is bolted on one side of the iron disk for fastening the counterweight to the end of the declination axis.

The tube of the telescope is made of 16-gage galvanized iron and is eight feet long. The mirror is permanently mounted in a specially made drum-like shell with one-inch angle-iron flange riveted on its edge. On the back of this are the adjusting screws, used to train the cone of reflected light rays on the prism.

Images of extremely faint objects can be seen with the best of definition. Among these are the individual stars of the great cluster in the constellation Hercules, many faint stars and nebulae, and a number of double stars which are commonly difficult to separate. The instrument is the largest in the United States south of latitude 33 degrees.

The writer desires to express his appreciation and obligation to Dr. A. D. Laugenour for his constant help and suggestions given to make the instrument a success.

A Goal Worth Striving For

The promise of a better world to live in are contained in a prose poem, written by one of our old readers, Walter G. Clark, an engineer who sees far over the immediate practical problems of our workaday world. How Mr. Clark came to write this poem—but let Mr. Clark tell it:

Mr. Orson D. Munn, Editor,
Scientific American.
My Dear Mr. Munn:

I am one of the diminishing number of oldtimers who has been a reader of the Scientific American since the days of its youth.

The Scientific American began coming into my possession in 1884, and I have always felt that during my early youth, the Scientific American exerted a very strong influence upon me and inclined me toward engineering and scientific work. To me it is the most readable and interesting of the American publications.

About two years ago, I saw in the Scientific American a paragraph entitled "Today and Tomorrow." That paragraph started me on a train of thought and as a result I wrote a few observations which I have termed "Yesterday, Today and Tomorrow." I am enclosing a copy herewith.

The editors of several periodicals and magazines have requested permission to publish this, but inasmuch as your publication suggested the idea to me, I have felt that I would prefer to see it appear in the pages of my old friend, the Scientific American. If you deem it worthy of space in your publication, I shall be glad to have you use it.

Trusting that the Scientific American may continue to appear and be of benefit to many generations yet to come, I remain

Very sincerely yours,
W. G. Clark,
Los Angeles, California.

Yesterday, Today and Tomorrow

Yesterday

Man power built the pyramids;

The sweating bodies of galley slaves propelled the ships;

The straining muscles of the ox broke up the sod;

Human backs, bent by labor, gleaned the fields and thrashed the meager yield of grain;

Tired fingers, spurred on by duty, prepared the fiber, spun the thread and wove the cloth.

Distance was measured by footsteps—days by the sun;

Communication awaited the will of wind and weather;

Action was limited by weary muscles, the mind by a horizon of fear, and safety lay in stealth and concealment;

The forces of Nature were manifestations of supreme anger or approval;

Pleasures were carnal, love was selfish, and life was short;

The future, a promise of punishment to be dreaded while living, and suffered when dead.

Today

Man commands electric power to build his monuments;

The steam turbine, powerful as a thunderbolt and obedient as a child, propels his ships of steel;

The tractor plows his field;

The harvester gleans more thoroughly than human hands;

The golden grain in quadrupled yield, thrashed and winnowed, is delivered by iron hands commanded by the brain of man.

THE STORY OF STEEL
by J. Bernard Walker
A story of America's leading industry
$3.15 postpaid
SCIENTIFIC AMERICAN
24 West 40th Street
New York

PATENT FOR SALE
Four-in-One Chicken Feeder—Patent No. 1485672. Practical for feeding without waste all kinds and sizes of poultry. Preventive of disease. Simple in construction, easy to clean and cheap to manufacture. Address M. E. Fielden, 542 Chetwood St., Oakland, Calif.

SELF INFLATING LIFE BELT
Pocket size. Wonder of the age. Miniature hollow ribbed life-boat distendable around body instantly. Sustains wearer in deep rough water. Most practical safeguard for sea travelers and non-swimmers. Boon to aquatic sports. Get free illustrated booklet.
SELF ACTING LIFE BELT CO. 55 E. 8th St., New York

TELESCOPES
CATALOG
W. & D. MOGEY
PLAINFIELD, N.J.

INVENTORS
Ideas Developed and Perfected
Models, Experimental work; labor-saving machinery for manufacturers. 20 years' experience.
BERNARD & HELLER 275 Water St., New York City

AGENTS 500% PROFIT
GUARANTEED GOLD LEAF LETTERS
For store fronts and office windows. Anyone can put them on. Free samples. Liberal offer to general agents.
METALLIC LETTER CO. 440 N. Clark, Chicago

BOILER PRESERVER
"UNISOL" chemically perfect feed-water treatment. Our new pamphlet on correct methods of treatment should be read by everyone interested in steam plants. Mailed on request.
Unisol Mfg. Co. Jersey City, N. J., U. S. A.

Print Your Own
Cards, Stationery, Circulars, Paper, etc. Save money. Print for others, big profit. Complete outfits $8.85. Job press $11, $29. Rotary $165. All easy, rules sent. Write for catalog presses type etc. THE KELSEY CO., P-42, Meriden, Conn.

Experimental and Model Work
Fine Instruments and Fine Machinery, Inventions Developed.
Special Tools, Dies, Gear Cutting, Etc.
HENRY ZUHR, Inc. 187 Lafayette St., New York City

KINKADE GARDEN TRACTOR
and Power Lawnmower
A Practical, Proven Power Cultivator for Gardeners, Suburbanites, Truckers, Florists, Nurserymen, Fruit Growers.
American Farm Machine Co.
1057 33rd Av. S. E., Minneapolis, Minn.
Catalog Free

MAILING LISTS
Anywhere and any kind furnished.
Catalogue and price list free.
NATIONAL LIST COMPANY
Dept. S A Newark, N. J.

WHY NOT spend Spring, Summer and Fall gathering butterflies, insects? I buy hundreds of kinds for collections. Some worth $1 to $7 each. Simple outdoor work with my instructions, pictures, price-list. Send 10 cents (not stamps) for my illustrated Prospectus before sending butterflies.
MR. SINCLAIR, DEALER IN INSECTS,
Dept. 36, Box 1424, San Diego, Cal.

BECOME A FOOT CORRECTIONIST
$3,000 to $10,000 yearly in a business of your own,—many are making it in the New Profession of foot correction, not medical nor chiropody. Openings everywhere with all the trade you can attend to; easy terms for license and training by mail; no further capital needed, or goods to buy; no agency or soliciting. Write today for full details.
STEPHENSON LABORATORY
23 Back Bay Boston, Mass.

Silk, cotton, wool and flax, by the magic of intellect, move swiftly from their birthplace to bobbin and loom,

Then, from a bath in liquid light, emerge as raiment gossamer fine, brilliant as the shimmering cloak of a dragon fly, or fleecy as eiderdown, in colors beyond the hope of Caesar, or the dream of Cleopatra.

The genie thus responding to the wish of Man, a machine needing the human touch only when an accident disturbs the harmony—

On wheels of steel and rubber tires and air-borne wings, our bodies rest while distance flies beneath our feet.

Radio, as fleet as light, brings distance near and millions listen to the voice of one.

The setting sun no somber shadow leaves, but in its place soft golden lights, commanded by the will of Man, delays the night and his children, from drudgery's burden free, find pleasure in the thus extended day.

The forces of Nature, now Man's slaves, obey his will;

The pleasure of mental mastery is first and consideration balances Nature's stern demands.

The Mind, no longer bound by witchcraft, threat or dogma, reaches backward into aeons of the past and forward into cycles yet to come and, free of fear, acknowledges Life to be a great adventure, and Death but one experience.

Man's neighbors are his friends and peace his heritage, disturbed only by lingering remnants of primitive desire.

Life is measured by accomplishment and if that accomplishment be for the benefit of others the future is enjoyed while living and the shroud of death is love.

Tomorrow

The accomplishment of the past will be recognized as but the index to future achievement;

Human minds will synchronize and cooperation will be the keynote;

Duplication, repetition, and competition will cease.

The futility of religious intolerance will be recognized;

Purely financial success will become a stigma and social mastery will be based on mental achievement and generosity;

The development of a common language will become an agency of peace.

Aerial transportation over land and sea will be safe and commonplace;

Swift and destructive aerial engines maintained by cooperating nations will prevent selfishness from generating war;

The release and control of atomic energy will emancipate the miner of coal;

Sight as well as sound will override the air, and radio, as quick as thought, deliver to the eye and ear antipodean events;

Astronomers will learn the distance and dimensions of the nearby stars and nebula, but not of the entire universe.

The separation of energy and matter will be accomplished to a degree which will permit the generation of essential substances;

The food problem for a dense population will be solved through synthetic chemistry and the development of rapidly growing fungus.

The quality of citizens, rather than the quantity, will be recognized as the desideratum, and births will be limited to the number which can be cared for and properly educated.

The prohibition of all detrimental drugs and drinks will become a matter of principle;

Biology, pathology, chemistry and surgery will extend the span of human life by preventive rather than by corrective measures.

The definition of God and Good will be recognized as that which adds to the total happiness of the human race, and the definition of Bad—all subtractions from that total.

Sunspots

Now that we are approaching the maximum of the regular 11.1-year sunspot period, numerous sunspots of great size have been noted. Indeed, some of them are "naked-eye" spots. They should go on increasing until 1929. Recently, Mr. Edison Pettit, of the Mt. Wilson observatory, established an interesting correlation between the number of sunspots and the amount of ultra-violet light we receive. This is important from the standpoint of helio-therapy, and an article on the subject has been promised us by a noted scientist. One of our readers who has been photographing a group of the large sunspots sends us the following letter, with a photographic print:

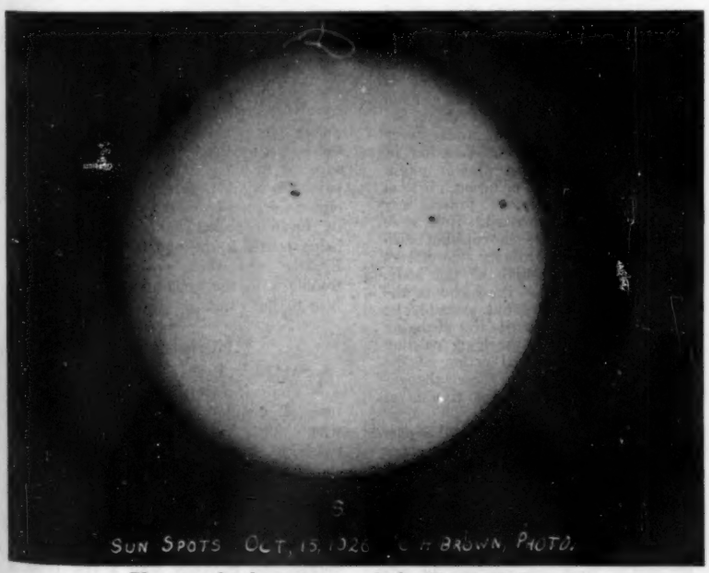
Editor, Scientific American:

For the past two years the writer has followed with much interest the articles on astronomy in your magazine. From time to time attempts have been made to photograph the sun and moon with the equipment on hand in my laboratory.

I am enclosing a photograph of the sun which I made on October 15, 1926, using a camera of the Eastman laboratory type, five feet long, a Cooke process lens, 18-inch focus, stop f-90, and a "five-times" projecting-eye-piece, as used in a microscope, placed at the focal plane of the above lens. The exposure was one one-hundredth of a second. This arrangement gave quite a large image and fairly good definition. As near as I can figure this is equivalent to a 21-foot lens. The largest spot is about 20,000 or 22,000 miles across, as near as I can measure it.

I consider the Scientific American one of the best magazines published as well as very educational.

Yours very truly,
C. H. Brown,
Edgewood, Maryland.



Photograph of sunspots made by Mr. C. H. Brown

SIMONDS
FILES

BACKED BY A NEAR-CENTURY'S EXPERIENCE

Simonds Files are made from Simonds Steel produced in a Simonds mill with characteristic Simonds regard for durability, strength and each file's adaptability to the work for which it will be used. The superiority of Simonds products—Circular, Band, Cross-Cut and Hack Saws, Files and Machine Knives—is founded on a near-century of experience in making cutting tools of tempered steel.

SIMONDS SAW AND STEEL COMPANY
"The Saw Makers" Fitchburg, Mass. Established 1832
Branch Stores and Service Shops in Principal Cities

"Dynamically Balanced" means

EVEN among those who buy motors, many do not realize what an important part dynamic balance plays in motor service. Dynamic balance eliminates noise, vibration and the costly repairs necessitated by the constant hammering of an imperfectly balanced armature. Every Dumore motor is safeguarded by the extra precaution of dynamic balance.

Our engineering department has helped many manufacturers to secure smooth, silent action and long life in their product, through the adaptation of Dumore universal motors. The dynamic balance of Dumore fractional horsepower motors will increase the saleability of your product. *Write!*

WISCONSIN ELECTRIC COMPANY
L. H. HAMILTON, President CHESTER H. BEACH, Vice-President
48 Sixteenth Street -:- Racine, Wisconsin

DUMORE
Fractional Horse Power Motors

FIVE BOOKS

recommended to readers

OF THE SCIENTIFIC AMERICAN

A panorama of our greatest industry.

THE STORY OF STEEL

by J. B. Walker

A complete yet not too technical account—from iron ore to the finished product—of this basic industry, written by the editor emeritus of the Scientific American. Told with all the knowledge and accuracy which make it of permanent value to scientist, engineer or layman. $3.00.

Romance upon a scientific background.

THE ROMANCE OF COMETS

by Mary Proctor, F.R.A.S., F.R.Met.S

"This is a popular illustrated account of comets and meteors. Miss Proctor possesses her father's gift for popular expression of astronomical matters, and her latest book will be welcomed by readers who are interested in the science without wishing to immerse themselves very deeply in its more technical details."—*London Times.* $2.50.

Laying bare the heart of the atom.

CONCERNING THE NATURE OF THINGS

by Sir William Bragg, K.B.E., F.R.S., D.Sc.

"This book is in our opinion the best popular exposition of the advancement of the physical science during the Twentieth Century that has been written. It is a clear and comprehensive answer, by a great master of research, to the ancient question, 'What is matter?' "—Elwood Hendrick. $3.00.

Einstein's theory of Relativity explained.

THE A. B. C. OF RELATIVITY

by Bertrand Russell

"The book cannot be praised too highly. It is pictorial without being superficial. It is scientific without being mathematical. It should do for Einstein what Galileo did for Copernicus."—Gerald Wendt, *N. Y. Herald-Tribune.* $2.50.

The inside story of broadcasting.

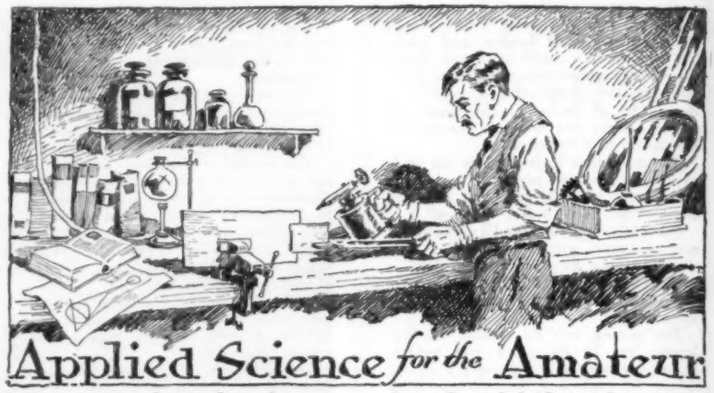
YOU'RE ON THE AIR

by Graham McNamee

This is not so much a technical description of broadcasting as an intimate glimpse of life in a great radio studio—amusing occurrences, the personalities, etc., as described by one of the most popular radio announcers in the country, "the man with ten million friends." $1.75.

HARPER & BROTHERS

Publishers since 1817



Applied Science for the Amateur

A department devoted to the presentation of useful ideas wherein will be found material of practical value for those who are mechanically inclined

Conducted by A. P. Peck

Science Applied to Sleep While Traveling

THE findings of scientists and research engineers are constantly being applied to everyday life, with the usual result that some comfort is added or some trouble relieved.

Those who travel considerably have probably wondered why the berths in a Pullman car are always made up with the head toward the forward end of the train. To show what science can offer as an explanation, we queried a man who has made a study of travel conditions, Dr. Thomas R. Crowder, Director of the Department of Sanitation and Surgery of the Pullman Company. He replied in part as follows:

"It is often stated that most people sleep poorly in sleeping cars. This is said to be due to riding with the head toward the engine. The explanation often offered is that when the brakes are applied and the train is rapidly slowed down, 'the blood tries to keep going at the same speed as before and in the same direction, that is, toward the head, until its inertia is gradually overcome,' the effect being to waken the sleeper.

"If the body were an inert mass, permeated with blood vessels and filled with blood as it is, the theory might possibly apply. But the body is far from inert. Its vascular system is endowed with a degree of responsive adaptiveness to changing conditions which, while marvelous indeed, is very real nevertheless. The amount of blood in any part of the body is not determined by so simple a process as the theory would have us believe. The blood-vessel walls contain contractile tissue which adjusts their size to the needs of the organ supplied, and this adjustment is both prompt and automatic, being controlled by the nervous system. Local blood-supply is constantly changing to meet changing local demands. Even without such adaptability I think the conditions described would produce very little effect, but with the function of the vessels intact, their prompt physiologic response to the changing physical conditions will, I am sure, prevent any such danger as is forecast. If it were not so we would be in constant difficulties from the ordinary movements and changes in position of the body. The static pressure of the blood in the brain, for instance, would probably be more greatly influenced by changing from the standing to the lying position than by the unhindered action of the forces. But we make these changes and movements without any trouble at all.

"There is no objection on the part of the Pullman Company to a passenger riding feet forward if he prefers, and on request his berth will be made up in that way. But there are good reasons for the general practise of riding other end first. The berth is a walled-off booth which receives a large part of its air supply from the windows in one side of it. So long as these windows are closed and the air comes in only by leakage through the crevices, it is not a matter of great importance which way the head is pointed. But if the window is open, even to the smallest extent, a definite current of air will enter and be directed toward the rear end of the berth, and that end then becomes less desirable to the unclothed head and face. Striking the partition at that end and the current being there slowed and diffused, the contained dust and cinders of the air are no longer held up but fall by gravity.

"Most travelers have probably sometimes noticed a collection of cinders and dirt on the foot of the bed in warm weather. One would not ordinarily select this dustiest and draughtiest place for his head. The forward end of the berth is, on the other hand, quite protected from direct draughts and is relatively free from dust. The rule and custom that obtains has been developed in accordance with this fact."

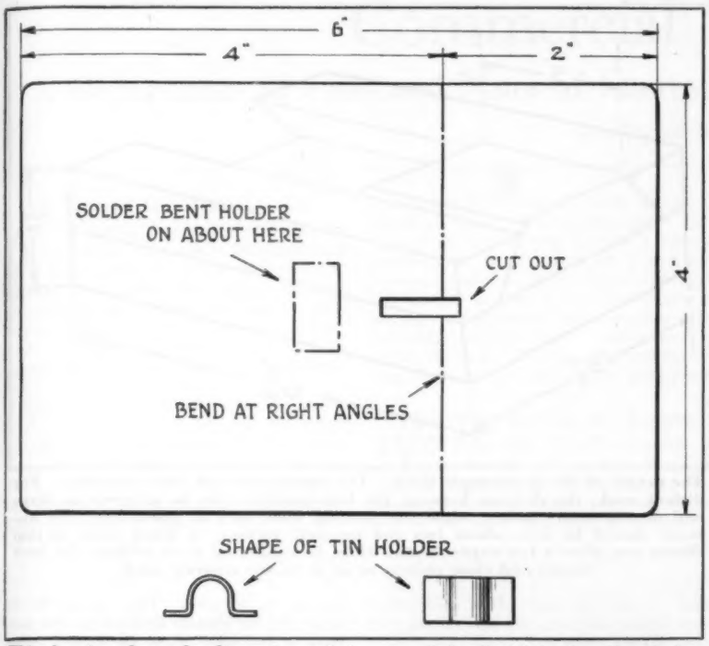
Electric Test-lamp

A COMPLETELY insulated socket of the porcelain type, equipped with heavy, well insulated leads about six inches long, should be part of the equipment of every electrical experimenter, and in fact, of every household which is wired for electric lighting. The ends of the short leads should be bared, so as to establish contact with the parts of the circuit to be tested.

One of the most important uses for such a device, in the household, is the determination of the location of a burned-out fuse. The procedure is simple. Usually a fuse burns out when some defective apparatus is being plugged into the circuit or while such a defective unit is being handled. This gives a clue to the cause, and before anything else is done, the cause should be removed. Then, being sure that one of the switches on the same line is turned *on*, place a 25-watt lamp in the test socket and go to the fuse box. Holding the socket by the insulated wires, and being sure not to touch the bare ends, place these points in contact with the two terminals on either side of one of the fuses. If the lamp in the test socket lights, the fuse that is being tested is the one that is burned out. Replace and then proceed to find the trouble with the apparatus that caused the fuse to burn out.

Simple Still

A SMALL still that will perform its function satisfactorily, when the temperature of distillation is not too high and where the quantities to be distilled are not too large, can be made without the acquisition of a "worm." A straight glass tube is bent so as to pass from the flask holding the material to be distilled to the receptacle for the distillate. Its length is covered with a loose, yet fairly heavy layer of absorbent cotton, held in place with a few turns of string or wire.

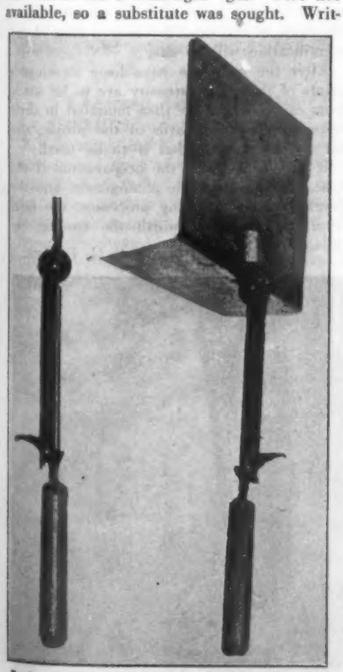


This drawing shows the dimensions of the pan of the flashlight "gun" and also the position of the slot and the tin "saddle" that holds the pan in place

After the apparatus is set up, the still is so located that cold water can drip on the layer of cotton. A trough can be arranged to catch the water as it falls from the cotton. If greater condensation is necessary, bend the delivery pipe in several places and allow more water to fall on the cotton.

Flash-light "Gun"

SOME amateur photographers spend the greater portion of their available capital for their camera and lenses and then find that they are "short" when it comes to purchasing the accessories that are not always necessary but which are often very convenient. This was the predicament in which Ross Bennett Walker found himself after he had purchased a camera with a lens, which as Mr. Walker says, will "get almost anything up to a black cat in a lightproof cellar." His particular "cat" which he happened to have to photograph was a new set of bells in the dark tower of a church. The funds for a flash-light "gun" were not available, so a substitute was sought. Writing in *Camera Craft*, Mr. Walker tells what he did, as follows:



Left: **The type of gas lighter that is used.** ***Right:*** **The finished flashlight "gun" ready for use**

"At a nearby 'five and ten' store I discovered and purchased a sparking gas lighter, one with a trigger and a handle. The things are sold all over the country for fifteen cents. On the way home I obtained at the tinsmith's a fairly heavy piece of scrap tin for five cents. With the aid of a pair of cast-off scissors a piece four inches by six inches was cut out, with the corners rounded to prevent catching and cutting of the operator. A hole was then punched with a screwdriver about two inches from the bottom and one and three-quarter inches from the side. The size of the hole was about three-quarter inch by one-quarter inch. Then the tin was bent (along the dotted line in the diagram) to make a right angle at the center of the punched out hole. A remnant of the left-over tin was cut, one and one-half inches by one inch, and formed to fit over the cap of the lighter, when soldered to the pan. With this piece soldered in place just above the hole, on the back of the pan, and the lighter fitted in, the gun was ready for action. When the trigger is pulled a hot spark occurs just in front of the opening in the back of the pan. A little depression can be made here to contain the powder, but I found it unnecessary.

"The total cost when completed was twenty cents, a saving anywhere from one to two dollars. Not much, perhaps, to some, but enough to keep the average photo-journalist in plates and paper for a week. The gun, in two pieces, is easily packed, and its extra height, of two inches more reflector, over the average commercial gun gives additional light. One marked feature in this gun is the lack of misfires; when it is kept clean a hot spark is made each time the trigger is pulled. New sparking metals are easily inserted; just remove the cap and the spring in the case and drop the metal down the tube."

The editor went Mr. Walker one, or in fact, two better. He purchased one of the gas lighters for only *ten* cents and used the metal of an old can for constructing the powder pan and reflector. Thus the total cost was reduced to only one dime.

When the editor constructed his "gun," following the suggestions given by Mr. Walker, he turned up the edges all around the pan where the powder is to be placed. Solder was then run in all the crevices. The turned-up edges and the solder serve to prevent the powder from spilling off, getting on the hand and probably causing burns to the photographer. This is particularly important if the pan is made smaller

LOOKING into the crystal suggests many changes in our big cities during the next 100 years. Perhaps there will be streets on three levels, towers topped only by taxi planes and aerial traffic lights.

But whatever new filing needs changes develop, there will be files bearing the Nicholson File Company trade mark made to meet them.

Look for the NICHOLSON trade mark when buying your files today. It guarantees you the best file workmanship the world has ever seen.

NICHOLSON FILE COMPANY
Providence, R. I., U.S.A.

NICHOLSON U.S.A. TRADE MARK

A File for Every Purpose

PATENTS

TRADE-MARKS
DESIGNS
FOREIGN PATENTS

MUNN & CO.

PATENT ATTORNEYS

Associated since 1846 with the Scientific American

SCIENTIFIC AMERICAN BLDG.
24-26 West 40th St., N. Y. C.

SCIENTIFIC AMERICAN BLDG.
Washington, D. C.

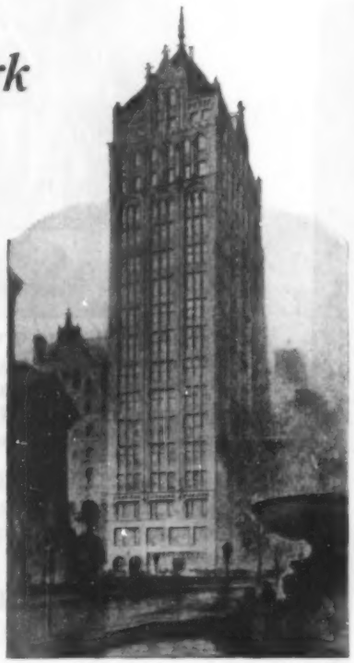
TOWER BUILDING
Chicago, Ill

HOBART BUILDING
San Francisco, Cal.

VAN NUYS BUILDING
Los Angeles, Cal.

Books and Information on Patents
and Trade-Marks by Request.
Associates in All Foreign Countries.

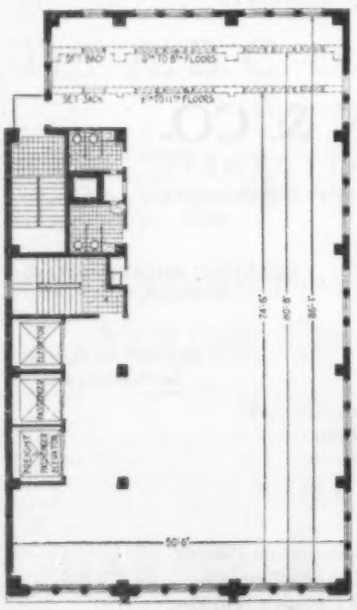
Move Your New York Office to the Scientific American Building



A new 16-story building—the Scientific American Building—has been erected on one of the most desirable office sites in the United States—at 24 West 40th Street, New York City.

Open to the sunlight on three sides, it is a half block west of Fifth Avenue and a block and a half east of Broadway. Across the street lies Bryant Park and the New York Public Library. It is four blocks from the Grand Central Station and eight blocks from the Pennsylvania Station.

Neighboring buildings include the American Radiator Building, the Engineers' Club, the New York Club, the National Republican Club and the Engineering Societies.



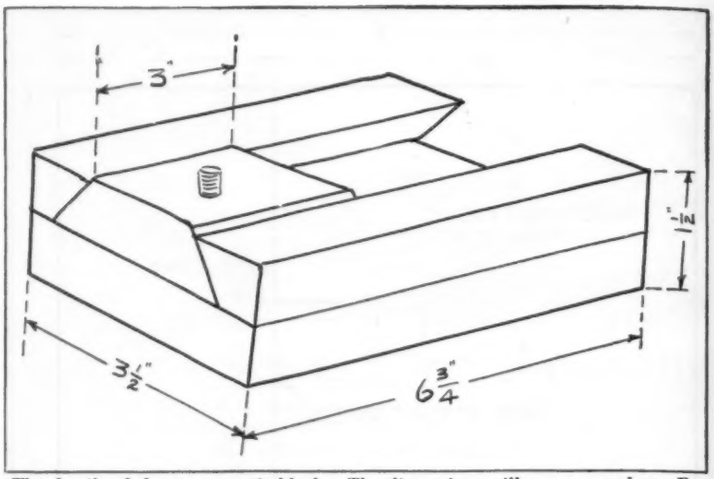
Should you be considering offices in New York City by all means investigate space in this attractive building—accessible, distinguished, desirable—and at rents which are reasonable.

Apply

CUSHMAN & WAKEFIELD, INC.

50 East 42nd Street
307 Madison Avenue
NEW YORK

TELEPHONE VANDERBILT 4200



The details of the stereoscopic block. The dimensions will vary somewhat. For distant work, the distance between the lens positions can be as great as three and three-quarters inches, while for close-up work such as portraiture, the distance should be less—about two and one-half inches. A block such as that shown can, after a few experimental trials, be calibrated as to settings for both distant and close objects so as to insure accurate work

than the one described. If a good job is done of the soldering, the pan will be very easy to keep clean.

Stereoscopic Photographs with a Single Lens

THE stereoscope that used to be a fixture in practically every parlor is now coming back into its own, at least as far as many enthusiastic amateur photographers are concerned. The hobby of taking photographs that can be viewed through a stereoscope with the usual relief effect is a most interesting one. There is one drawback to the pursuit of this work and that is the cost of a camera that will take two pictures simultaneously and from two slightly different points. This, under ordinary conditions, requires two lenses, which of course increases the camera cost. If, however, certain precautions are observed, a special bed for the camera is built, and the amateur will be content to photograph only still objects, very creditable stereoscopic views can be taken with an ordinary single-lens camera.

The only special apparatus that need be made in order to accomplish this work is the camera base that is to be mounted between the camera proper and the head of the tripod. This may be constructed of wood with the part that is attached to the camera so arranged that it will slide smoothly on the other section. A tripod socket is fitted to the underside of the lower piece and a tripod thumb-screw is so arranged in the upper section that the camera can be fastened to it. The hole in the upper section must be countersunk so that the head of the thumb-screw will not interfere with the sliding action.

The exact dimensions of the two sections of the bed will depend on the size of the camera to be used. They should be so made that the distance between the two positions of the lens, when the sliding block is shifted from one end to the other, will be approximately two and one-half inches. This is so that the two views which are taken of the same object will be exposed from points that are about the same distance apart as the human eyes.

After the special bed is made, the lower section is fastened to the tripod with the regular tripod screw. It is well to emphasize here that the tripod used when taking stereoscopic pictures must be strong and rigid so that it will not move when the sliding block is shifted.

The upper section of the bed is fastened to the camera and the two blocks are placed together. The camera is then focused on a scene in which there are no moving objects. This is done with the sliding block flush with one edge of the stationary part of the bed. One exposure is made. The camera is then shifted so that the sliding block is flush with the opposite edge of the lower part and after the film has been wound to the next section, another exposure is made, using the same aperture and time as for the first one.

If an autographic type of camera is used, it will be wise to mark those negatives that are made at the same location so that future identification will be easy.

After the negatives have been developed, prints of the same intensity are to be made from each. These are then mounted in their respective pairs on cards of the proper size for the stereoscope that is to be used.

If care is taken in the preparation of the base, the taking of the photographs and the developing and printing processes, the final result will be well worth the trouble entailed.

Contributed by EDGAR G. PFARRE.

Two views taken with the stereoscopic attachment described. When mounting such photographs, do not leave a wide white space in the center

Commercial Property News

A Department of Facts and Notes of Interest to Patentees and Owners of Trademark Rights

Conducted by Milton Wright

A Record for Trademarks

A NEW step in the process of protecting trademarks has recently been perfected by a leading firm of patent attorneys. It consists of a form upon which may be recorded all the evidence necessary to protect a trademark in the event of a dispute over the rights to ownership. It applies equally to trademarks which are registered and those which are not.

Many businesses are built around trademarks. In some cases the good will value of the trademark exceeds all the other assets of the company or firm. However, far less care often is taken of it than of any piece of furniture in the office. Some business executives seem to feel that once they have adopted a mark, used it and registered it in the United States Patent Office, they need never give it any further thought.

Because of their enormous good will value, trademarks are frequently the subject of dispute. In fact, the more value a trademark has, the more likely it is to be imitated or infringed or attacked as to its validity.

While it is true that a trademark rightly belongs to the man who was the first to adopt and use it in commerce, this early use is often a matter of evidence It is surprising to learn how often this evidence has been carelessly lost or destroyed. Many a trademark user has lost his rights, because of lack of evidence, in favor of another manufacturer using the same mark on like merchandise.

There has been an increasing necessity for a complete, standard form upon which all the necessary evidence in connection with a particular trademark could be assembled for safe keeping and ready reference. This is now provided by the record mentioned. Its use by business houses probably will be widespread.

The record provides for the goods with which the mark is used, the method of affixing, the date of first interstate use, the office files where the records may be found, the date of registration, the date of expiration and other facts necessary.

The record form is being distributed free to business houses by the firm of patent attorneys who originated it.

Chewing Gum Patents

WHETHER a patent for chewing gum is valid, and if valid, if it is infringed, may depend upon whether or not one of the ingredients is mixed in the gum itself or in the sugar coating. Upon such a point the recent infringement suit brought by the Health Products Corporation in the Federal Court in New York City against the Ex-Lax Manufacturing Company was decided in favor of the plaintiff.

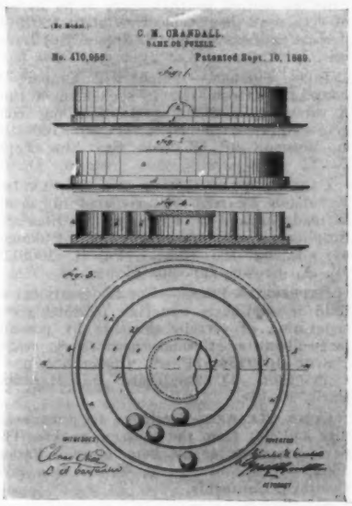
"Sultzberger (the patentee) discovered no new purpose for phenolphthalein," rules Judge Moscowitz. "It had been known as a laxative for many years." Phenolphthalein combined in the candy coating surrounding the gum produced no new and useful result. The effect of phenolphthalein is valueless when placed in chewing gum. The patent is void for lack of invention.

"The Sultzberger patent calls for the phenolphthalein to be placed in the gum center. The defendant's chewing gum product contains phenolphthalein in candy coating as distinguished from placing it in the gum center. Since the defendant does not manufacture its product by placing phenolphthalein in the gum itself, as stated in plaintiff's patent, it does not infringe."

Among the chewing gum patents mentioned by Judge Moscowitz are the one granted in 1869 to Semple as a dentifrice to be chewed to clean the teeth, the one to Kilbourn for a chewing gum mixed with peanut oil and balsam tolu as a tobacco antidote, the one to Lynch for a gum containing buttermilk bacilli, and even the patent granted to Tyler for a chewing gum to be used by plasterers and containing olive oil and rosin, the olive oil being used to soften the rosin. The resulting combination was then to be used as a plaster sizing agent.

The "Pigs in Clover" Lesson

WHICH is more valuable, a patent or a trademark? The answer, of course, depends upon the particular patent and trademark involved. One may come to the aid of the other and help it to make a fortune. To illustrate, we quote from records.



Do you remember "Pigs in Clover," one of the most famous and profitable puzzles ever to become a popular fad? The patent claims were narrow and in a crowded art, but the trademark seized the public's fancy and acted as a perfect defense against a swarm of imitators

On February 1, 1889, Charles M. Crandall, inventor, and Moses Lyman, his financial backer, both of Waverly, New York, applied for a patent on a simple little puzzle. Seven months later the patent issued. When put on the market it took the country by storm. Scarcely a family anywhere was without one. The net profits are said to have totaled more than a million dollars.

The device was not very different from hundreds of other puzzles and it was inexpensive to make. A score of other manufacturers, seeing the success of Crandall and Lyman, put out similar puzzles but changed them just enough to avoid infringement. For purposes of entertainment they were just as good as the original. Not one of the imitators made a success, however, and here is the reason.

Lyman, on February 28, 1889, filed an application to register as a trademark the words "Pigs in Clover." Registration was allowed two months later. The public flocked to toy, department and novelty stores to get the patented puzzle called "Pigs in Clover." They would take nothing else just as good which might be known by another name. The trademark made the patent a commercial success.

An Invention by a Specialist

A THEFT-PROOF mail-bag lock has been invented and a patent applied for on it in the Canadian Patent Office. The invention also does away with all ropes, straps or steel bars, thus lightening the bag considerably, as well as preventing its being rifled by bandits. The inventor is Norman ("Red") Ryan, notorious Toronto bandit who is serving a life sentence for bank robbery in the Portsmouth Penitentiary.

Bill Would Compel Patent Notice

A BILL to make it the duty of all patentees or persons making or vending patented articles to give sufficient public notice that the articles have been patented has been reported to the House of Representatives by its Committee on Patents.

According to the provisions of the bill, the patentee or vendor shall use on the article the word "patent," together with the number; or when, from the nature of the article, this cannot be done, he shall affix to it or to the package a label carrying the notice. With patents issued prior to April 1, 1927, the notice shall consist of the word "patented," together with the dates of the granting of the patent.

The Inventor and His Employer

AN important phase of patent law little understood by laymen is the relation between an inventor and his employer. Upon this subject a recent decision by Alvin E. Mambert, referee, denying the injunction sought by Myrtle M. Naylor, a stockholder, to restrain the Ludlum Steel Company from paying royalties to Percy A. E. Armstrong, inventor of processes for making a "foolproof" chisel steel, stainless and rustless steel and other inventions, is illuminating.

Armstrong entered the employ of the company as sales manager in 1917, under a written contract to give all his time and services to the company at a fixed salary and a stipulated commission on sales. Later he became a director and vice-president. In 1925 he resigned. Being a metallurgist, he made numerous discoveries and inventions during his employment and obtained patents in his own name for them. In making them he was assisted by the company's employees, and used its plant, materials and equipment, and it paid the cost and expenses of the work, as well as the costs of getting patents. In 1923, he assigned the patents to the company, in return for an agreement to pay him a certain percentage of the net profits on products sold under his patents. The plaintiff challenged the validity of this contract.

The referee, in sustaining the validity of the contract between Armstrong and the company, stated:

"I am satisfied from all the evidence and briefs that the defendant Armstrong was generally employed and not specifically employed to discover and invent and that he was not in duty bound to assign to the Ludlum Steel Company any patents he might obtain while so employed."

"Ripleene" and "Ripplette"

USUALLY when a trademark owner opposes the registration of a trademark similar to his, the offending mark is used with goods he considers inferior or of equal quality. When the Haas Brothers Fabrics Corporation recently sought to register "Ripleene" for sheer-silk piece goods, however, they found their application opposed by Bliss, Fabyan and Company, who previously had registered "Ripplette" for fabrics composed of cotton and artificial silk. The contest was taken to the Court of Appeals of the District of Columbia.

"It is quite certain," writes Chief Justice Martin, "that marks so nearly identical as these, if applied to goods having the same descriptive properties, would confuse the ordinary purchasing public as to the origin of the goods, and lead to injustice as between the parties.

"We are equally confident that the goods in question, as shown by certain of the exhibits, are of the same descriptive properties, and that the purchasing public seeing them sold under the same mark, would naturally believe that they had the same commercial origin in point of manufacture or marketing."

Colors Cannot Be Registered

EVERY once in a while some manufacturer tries to register a distinctive color as his trademark. He is always turned down. The latest is the Turner and Seymour Manufacturing Company, which sought to register as a trademark the blue color of the handles of kitchen utensils.

"The applicant's mark consisting in coloring the grip portions of handles kitchen blue, is not registrable," Assistant Patent Commissioner Moore holds, "in view of the authorities cited by the registrant in its brief. All handles of household tools and kitchen utensils are necessarily characterized by some color or colors.

"Kitchen blue is not more distinctive than any other color that may be selected for the handles of articles of trade. No man should be given a monopoly of color alone as a trademark. When it is impressed in a particular design as a circle, square, triangle, a cross or a star, it may constitute a valid trademark."

A Chicago Boycott Trust

AN agreement between manufacturers, contractors and carpenters, whereby a refusal is made to work upon any non-union millwork, is contrary to the Sherman Anti-Trust Act, the United States Supreme Court holds in reviewing the conviction of Chicago building men for engaging in a combination and conspiracy to restrain trade.

The agreement was made when Chicago manufacturers found their business impeded by the competition of non-union mills in Wisconsin and the south, which sold their window and door fittings, sashes, baseboards, moldings, cornices and other millwork more cheaply in Chicago than the Chicago manufacturers, who employed union labor. The operations of the Chicago mills were thus

cut down and they employed fewer carpenters. The agreement was effective.

"The local manufacturers, relieved from the competition that came through interstate commerce, increased their output and profits," Judge McReynolds writes, "they gave special discounts to local contractors; more union carpenters secured employment in Chicago and their wages were increased. These were the incentives which brought about the combination. The non-union mills outside of the city found their Chicago market greatly circumscribed or destroyed; the price of buildings was increased, and, as usual under such circumstances, the public paid excessive prices."

Science in the Five and Ten

THE Woolworth stores have been applying scientific management with great success. Analyzing their stocks of merchandise, eliminating duplicates and specializing in those for which the public expresses a preference, they have cut down the number of individual articles handled to 3,000. The result has been that they have increased their turnovers from six to eight a year, thus heightening the rate of profit on the capital investment.

Defeated by His Own Invention

IT is not uncommon for an inventor to find that he cannot get a patent because his own previous invention stands in his way. There is nothing he can do about it.

Such was the case recently with William L. Sullivan who applied for a patent on a ticket-issuing machine—one of those devices with a long strip of tickets where the ticket seller can press a key and cut off as many tickets as may be desired. When the Patent Office, on the ground of lack of patentable novelty, refused to issue him a patent, he appealed first to the District Court in New York and then to the Circuit Court.

"Since almost all patents, and this one is no exception to the rule, consist in taking the 'last step that counts,'" Judge Hough writes, "it is always necessary to ascertain where the inventor was and what the art was when he began to take his step.

"Particularly there existed Sullivan's own machine, described in an application filed by him three years before, and, as the evidence shows, made and put on the market. There was also a machine of which he was co-inventor, contrived for the same purpose but actuated by a treadle instead of electricity.

"The point of this case is, not that the two Sullivan patents were copending, but that what the patentee knew, and put into his earlier application, he could not assert to be new when he filed his later one. His second step could only begin where his first stopped. His knowledge is not imputed to him by any proceeding in the Patent Office; he acquired it by the efforts of his own mind."

British Commercial Monomarks

A RESIDENT of Manchester, England, visits Edinburgh and buys a pair of shoes branded "Esiwalk," which wear remarkably well. When they wear out, he wants another pair just like them. He does not know the address of the Edinburgh store. What does he do?

If the maker has registered with British Commercial Monomarks, Limited, the problem is easy. He looks in a shoe, sees some such cabalistic combination of letters as "BCM-ESI-WALK" stamped on them, addresses a post card to "BCM-ESI-WALK" and asks what store in Manchester carries Esiwalk shoes. The post card is passed along to the manufacturer and then to the retailer.

Such is the working of the recently developed British Commercial Monomark system. Each subscriber to the service is assigned an individual monomark. This includes the letters BCM, followed by a letter and number group, a word, or trademark as desired. Monomarks, consisting in part of a trademark, whether registered or unregistered, are issued only to the lawful owners of such mark as determined by an inclusive list of trademark owners on record with the company.

Patents Recently Issued

Classified Advertising

Advertisements in this section listed under proper classifications, rate 25c per word each insertion; minimum number of words per insertion 24, maximum 60. Payments must accompany each insertion.

Official copies of any patents listed in this section at 15c each; state patent number to insure receipt of desired patent copy.

Pertaining to Aeronautics

AIRPLANE.—In which is provided automatic transverse stability by the provision of combined automatic means for obtaining both longitudinal and steering stability, independently of the translational speed of the plane. The inventor has been granted two patents of a similar nature, 1607577 and 1607578. A. Tammeo, c/o G. Capuccio, Via Arsenale N. 17, Turin, Italy.

DRIVING APPARATUS FOR HIGH-SPEED LOCOMOTIVE CRAFT.—Particularly adapted for aerial and other craft, greatly diminishing the resistance to penetration of the craft into its surrounding fluid. Patent 1611658. P. Magni, c/o Barzano & Zanardo, 9 Via Due Marcelli, Rome, Italy.

Electrical Devices

ELECTRIC MOTOR FRAME.—For supporting the armature while it is in the housing, independently of the bearings, so that the latter may be removed without changing the armature position. Patent 1608697. R. E. Jacobs, 2323 Haste St., Berkeley, Cal.

POCKET ELECTRIC LIGHTER.—Of a size for snugly fitting into an ordinary garment pocket, and having a combined cover for the lighting member and the switch. Patent 1610135. G. D. Kelsey, 44 First Ave., Hawthorne, N. J.

GAS-DETECTOR ALARM AND VALVE-ACTUATING MEANS.—Whereby the escape of gas from a system will so effect the apparatus as to cause a valve to shut off the gas supply. Patent 1600930. A. Cohen, 133 Division St., New York, N. Y.

ELECTRIC SWITCH.—A key-operated cut-off, cooperably arranged with the starting switch of an automobile, rendering the switch inoperative when turned to "off" position. Patent 1610835. A. E. Westburg and H. A. Weinke, 308 Broadway, Yankton, S. D.

ELECTRIC TRANSMITTING DEVICE. — Adapted to transmit the reading of an indicator of liquid levels to another indicating device disposed at a distant point. Patent 1610546. F. A. Brandecker, 937 Olive St., Coronado, Calif.

SPARK PLUG.—Which will be "sturdy" in construction, easy to assemble or dissemble when renewing electrodes, and will prevent accumulation of carbon. Patent 1612091. P. Bernal, 760 10th Ave., Honolulu, Territory of Hawaii.

TROLLEY CONSTRUCTION FOR ELECTRIC CRANES.—Having a replaceable wear filler piece, so that when the same wears through the entire slide need not be scrapped, a new filler being substituted. Patent 1612648. C. H. Pollard, Wheelersburg, Ohio.

BATTERY.—A wet battery, which may be easily slipped into the cage provided in a motor vehicle, without additional space being required for the handles. Patent 1611532. A. Kastelic, 311 23d St., Richmond, Calif.

Of General Interest

FLOW BOX FOR OIL LINES.—Connected in such manner that the operator is able at any time to observe the rate of flow and character of the fluid. Patent 1608369. H. A. Campbell, c/o T. Lomax, 541 Harvey Snyder Bldg., Wichita Falls, Texas.

GATE.—Pivotally mounted at one side of an entrance and weighted so that little manual force is required to initinte the opening or closing. Patent 1607733. J. E. W. Fogal, c/o F. A. Southwick, Upright Gate Co., Quincy, Ill.

APPARATUS FOR THE ABSTRACTION OF GASOLINE.—A device in which the latent heat of absorption of the oils in the gas is adapted to furnish the heat for the evaporation of the oils. Patent 1607942. C. H. Brown, c/o Brown Welding & Machine Co., Breckenridge, Texas.

LEDGER.—Employing leaves of novel construction whereby any name in the ledger may be instantly found without turning through a number of leaves. Patent 1607953. H. J. Holst, Platteville, Colo.

BRICK-ICE-CREAM HOLDER. — Constructed of edible material, for holding a slice of brick ice cream in a substantially horizontal and convenient position for eating. Patent 1607664. M. E. Carpenter, 2730 Oliver St., Fort Wayne, Ind.

JAR CLOSURE AND BRUSH.—Comprising a cover, a removable cap to the cover, a brush, and an annular flange forming a recess for receiving waste drippings from the brush. Patent 1607702. R. Siline and L. Johnson, P. O. Box A, Wapello, Iowa.

CLOTHESPIN.—Which is more easily manipulated than the ordinary pin, and will grip the clothes so that there is no danger of accidental displacement. Patent 1607945. J. L. Centlivere, 311½ S. Second St., Laramie, Wyo.

BOOK HOLDER.—Which will support a book in open condition in such manner that a person in a reclining position may conveniently read the book. Patent 1609180. I. Motono, 146 W. 65th St., New York, N. Y.

CARRIER AND GAUGE FOR EXPANDING EYEGLASS FRAMES.—Constructed to permit of ready expansion of the eyeglass rims and forming an efficient gauge without danger of marring the same. Patent 1609110 W. A. Brown, Lincoln, Maine.

EXPRESSING PRESS.—For the treatment of fluid or semi-pasty materials permitting the separation of certain elements by passage and filtration through perforated walls. Patent 1609154. P. A. Carteret, c/o C. Chassevant, 11 Boulevard de Magenta, Paris, France.

COMB CLEANER.—Designed to remove all dirt and lint from the teeth of combs. The device is very easily kept clean. Patent 1602255. Jacob Schmid, P. O. Box 268, Coalinga, California.

SIZING COMPOSITION. — Consisting of pitch, spirits of turpentine and linseed oil, which may be applied to a newly plastered wall, and the paint put on almost immediately. Patent 1609174. W. W. Leake, c/o Hunter C. Leake, Hibernia Bank Bldg., New Orleans, La.

FLUSHING VALVE.—Wherein the parts are so formed that the opening lever may be shifted around the casing of any desired point, eliminating different forms of inlet members. Patent 1609193. W. A. Pratt, 1130 Avenue "C," Bayonne, N. J.

MOP.—The cleaning element of which may be readily associated with any type of staff, without the use of rivets or wires. Patent 1609157. E. T. Crater, c/o Mrs. E. T. Crater, 8615 24th Ave., Brooklyn, N. Y.

ADJUSTABLE FLOWER-DISPLAY FIXTURE. —Especially adapted for displaying flowers either in pots or other receptacles, the device may be readily adjusted as to height and angle. Patent 1609246. S. Hamburger, c/o W. P. Warshauer, 706 Avenue "C," Brooklyn, N. Y.

PERPETUAL CALENDAR.—May be used from month to month and year to year by a simple adjustment and adapted for use upon a fountain pen, pencil, upon a pillar such as in a bank, upon a paper weight, etc. U. S. patents 1500913 and 1551530 and Canadian patent 241649. Donald R. Adams, Box 470, Fairbanks, Alaska.

CHECK HOLDER.—A combined holder and and punch for holding the checks given by waiters and waitresses to patrons, and for denoting the amount of the bill. Patent 1608567. F. W. Schooley, Room 501, Plymouth Court, Chicago, Ill.

COTTON-BALE COVER.—Constructed to confine the cotton uniformly and firmly, and to effect an economy in the quality of fabric for covering the framework. Patent 1609,030. I. Margolius, c/o Security Bagging Co., Norfolk, Va.

LETTERING PEN.—Which will be durable, particularly adapted for the broad marking

Bumper Patent Infringed

"IT would appear to be that the Lyon buffer proved to be the first successful bumper, that the loop ends produced a spring construction of great resiliency, making little difference as to what part of the bumper was struck," writes Judge Inch of the Federal Court for the New York District, restraining the Bethlehem Bumper Company from infringing the patent issued to George A. Lyon in 1916, and now owned by Frederick W. Hilditch.

"The various learned and technical arguments advanced by experts for defendant to the effect that instead of depending on the resiliency of the loop ends, defendant's bumper depends for resiliency on the impact portion itself, and similar claims, illustrated by pressure loads, have been duly considered but all such claims must be viewed in the light of defendant's actual bumper construction which was before the court."

Alcohol Rub Trademarks

THE Fries and Fries Company and the Excel Company, both manufacturers of denatured alcohol for massage purposes, found their applications for trademark registry in interference recently. The former sought to register "X L-Rub" and the latter "Excel-Rub." The Commissioner awarded registration to "Excel-Rub" by reason of priority of use of the particular mark in question.

When the case was heard by the Court of Appeals for the District of Columbia, Fries and Fries produced an assignment of the mark given them by the X. L. Pharmacal Company in 1924, allowing the assignees to date their title to the mark back to 1913. It was no use. The court observed that the assignment was acquired two years after Fries and Fries' application for trademark registration was made, and held that all they acquired by the assignment was the right to use the mark against its prior owner.

Colors May Clash in Trademarks

"NO court, so far as I know, has ever held that a manufacturer was entitled to the exclusive use of a particular color for its containers," Judge Goddard declares in denying a motion of the Caron Corporation to restrain Richard Hudnut from using black and gold perfume bottles. "Obviously, this would create an extraordinary situation. But it is well settled law that one may not adopt the same or a similar combination of colors and styles for containers, labels, et cetera, as that used by another, where the result tends to mislead the ordinary purchaser into believing that he is purchasing the product of one manufacturer, when in fact he is getting another's.

"The combination of plaintiff's box and bottle, and the combination of defendant's box and bottle are not such, in my opinion, as to tend to mislead a purchaser into mistaking one for the other."

Crucifixes and Rosaries

IS a crucifix an "article of religious devotion similar to a rosary?" "No," said the customs men. "Yes," said Benziger Brothers, importers. The rate of import duty depended upon which was correct.

"The crucifixes here are, undoubtedly, articles which incite religious devotion," said the Court of Customs Appeals, "but how can it be said that they are similar to rosaries and chaplets, the main purpose of which is, as those words are commonly understood, to aid the memory in keeping a count of the number of prayers said, we are unable to understand." Therefore the court sustained the duty assessed at the rate provided in paragraph 399 of the Tariff Act.

of lettering lines, and may be used with ink, water colors or oil paint. Patent 1608570. E. C. Tuggle, Box 169, Sharon, Pa.

SUPPORTING DEVICE FOR CAPS.—For advantageous individual display, and in such manner that the caps may be associated with or taken from the support without injury. Patent 1608758. S. E. Alexander, 1113 Commerce Ave., Longview, Wash.

PLAYING CARDS.—Having symbols by which the diamond and club suits may be instantly distinguished from the heart and spade suits, by a lower degree of visibility. Patent 1608127. A. Lefebure, 891 Post St., San Francisco, Calif.

UMBRELLA CASING.—For use in automobiles so that wet umbrellas can be stowed away without damage to the upholstery of the car; the receptacle is removable when desired. Patent 1610026. E. Miller, c/o W. Miller, 19 W. Broadway, New York, N. Y.

FASTENING DEVICE FOR MILK-CAN COVERS.—Permanently attached to the can, but permitting the cover to be readily manipulated for filling and discharging, and is adjustable for locking. Patent 1610114. J. F. Wheeler, Grand Valley, Colo.

PHONOGRAPH CONSTRUCTION. — Whereby the tone arm can be very compactly stowed away when not in use and readily moved to an operative position. Patent 1610129. S. A. Goldberg, c/o Plaza Music Co., 10 W. 20th St., New York, N. Y.

PEN AND PENCIL CASE.—A simple device whereby pens and pencils can be prevented from working out of a pocket, by being gripped within a case, without cutting the pocket. Patent 1610110. D. I. Reiter, 100 Fifth Ave., New York, N. Y.

SHIPPING CONTAINER.—Having a separate body, top, and bottom with locking members, so constructed that pilfering the contents without permanent injury is prevented. Patent 1609495. C. B. and R. W. Pool, c/o Pool Mfg. Co., Stamps, Ark.

PHONOGRAPH TURNTABLE.—For use with portable phonographs, to support disks of standard sizes, yet capable of being collapsed to occupy a very small space. Patent 1610130. S. A. Goldberg, c/o Plaza Music Co., 10 W. 20th St., New York, N. Y.

FURNITURE SPRING.—For beds, couches and the like, the upper and larger ends of the springs being connected and braced to preclude any relative circumferential shifting. Patent 1610104. V. Massacese, c/o Attilo Verna, 476 Ninth Ave., New York, N. Y.

LOOSE-LEAF BINDER.—Having a wide range of utility for binding blank leaves, filing single leaves or folded letter sheets, or may be used as a notebook. Patent 1610992. J. V. Belli, 45 Mahar Ave., Clifton, N. J.

ATTACHMENT FOR RAZORS.—For supporting a Gillette blade in proper position to be sharpened by an auto-strop bladeholder and strap, the blade being readily applied or removed. Patent 1611055. P. E. Menzel, Apt. 6C, Sickles St., New York, N. Y.

BATH CABINET STRUCTURE.—Which may be readily set in place in conjunction with a shower bath, and will also serve as a screen to prevent splashing. Patent 1611096. D. M. Alexander, 16 De Lap St., Jamaica, L. I., N. Y.

COMBINATION CIGARETTE CASE, MATCH BOX AND ASH TRAY.—Holding the above mentioned objects, with the compartments in the case so coordinated that they are readily accessible. Patent 1610647. F. G. Anderson, Box 236, Penticton, B. C., Canada.

FRAME HOLDER.—For a canopy or awning, preventing the bodily upward movement of the movable frame section when disposed in active position. Patent 1611077. G. Rivoire, 33 Broad St., Stapleton, S. I., N. Y.

TRUNK.—Having the appearance of an ordinary trunk, but may be extended for use as a wardrobe for the accommodation of topcoats, trousers and the like. Patent 1611034. J. Holm, 1919 Dewey St., Butte, Mont.

GLASS-CUTTING DEVICE.—In which the holding means is actuated by spring pressure, permitting glass of various thicknesses to be securely held without danger of breaking. Patent 1610547. J. Burda, 2743 Southport Ave., Chicago, Ill.

BAIT CONNECTER.—An angling device by means of which the hook carrying the bait can be quickly applied or released by a tapered spiral. Patent 1611308. G. E. Gicker, 1625 Atlantic St., San Diego, Calif.

WINDOW.—Of the steel type, having pivotal means which will permit of the swinging of the sash section even though the latter be bent or deformed. Patent 1611661. B. Mayer, 1519 Music St., New Orleans, La.

CLARIFIER.—Of the centrifugal type designed more particularly for clarifying liquids that make the cleaning of the bowl difficult. Patent 1611725. J. Degerth and F. Mortensen, c/o Maskin-Och Brobyggnada Aktiebolaget Helsingfors, Finland.

WINDOW SEAT.—Which extends outside of the building and when once adjusted can be removed from one window to another for the use of workmen. Patent 1611649. R. R. Laurita, c/o A. T. Bedard, 2516 Woodbine St., Brooklyn, N. Y.

CLEANING DEVICE.—Compact in structure, adapted for carrying a cleaning substance for the removal of grease spots and other stains in wool or cotton garments. Patent 1611525. G. E. Hendrickson, Argyle, Wis.

Hardware and Tools

BIT-SOCKET ATTACHMENT. — Easily adjusted to frictionally engage with the clamping sleeve to hold the sleeve against turning on the shank when the bit-stock is in use. Patent 1610785. A. A. Jacobi, Box 551, Sagamore, Mass.

DOOR CHECK.—Which will check the swinging movement and prevent the slamming of a door either to closed or fully open position. Patent 1610404. E. M. Winfrey, 816 Scott Ave., Wichita Falls, Texas.

RAKER GAGE AND JOINTER.—For use in filing the raker teeth and adjustable to set the tool for cutting the raker teeth shorter or longer. Patent 1611113. H. Grandmaison, Beaver River, N. Y.

CAN OPENER AND TIN SHEARS.—So arranged that the tin will be held in accurate cutting position, sufficient leverage being provided for the cutting of comparatively heavy tin. Patent 1611061. E. M. Palm, c/o F. Larson, 558 50th St., Brooklyn, N. Y.

PISTON-RING TOOL.—For holding the flexible resilient ring-embracing member in approximately ring form so as to facilitate the fitting of the member over the ring. Patent 1612626. H. A. G. Fornelius, 554 Clifton Ave., Clifton, N. J.

Heating and Lighting

FURNACE FOR MELTING METALS.—Having pendant side walls and an adjustable roof, allowing arch space above the ore bath, and being productive of fuel and metallurgical savings. Patent 1608557. J. C. Greenway, c/o Mrs. J. Greenway, Ajo, Arizona.

GAS HEATER.—Having means for distributing the heated air laterally around, the device does not require any attention for its efficient operation. Patent 1610332. A. A. Smith, 12032 Parnell Ave., Chicago, Ill.

UNDERSEA LIGHT.—Including a lamp bulb of sufficient strength to resist high pressure, which will give a relatively powerful illumination and may be readily manipulated by a diver. Patent 1611651. B. F. Leavitt, 1120 Nostrand Ave., Brooklyn, N. Y.

HUMIDIFIER FOR HOT-AIR FURNACES.—Which will evenly supply among several hot-air flues of a furnace the desired amount of moisture without periodical replenishment and but little attention. Patent 1611633. M. D. Cohen, 1001 Independent Life Bldg., Nashville, Tenn.

HEATING FURNACE.—In the form of a one-pipe furnace consisting of the combination of metallic jackets and a central brick core for heating the air. Patent 1612115. J. Hermans, R. F. D. No. 6, Box 75A, Vancouver, Wash.

OIL BURNER.—Wherein a minimum of oil is consumed, and the oil, steam and air are most thoroughly mixed to produce a maximum of heat. Patent 1612653. A. M. Rodriguez, Cranford, N. J.

HEAT DISTRIBUTOR.—For disposition over a gas stove, or the opening of a coal stove, for conveying the maximum amount of heat to a kettle or pan. Patent 1613534. N. E. Rice, 7743 W. Grand Ave., Chicago, Ill.

Machines and Mechanical Devices

WATER WHEEL. — For use in elevating water, constructed with a continuous annular rim, of circular cross section, and having inlet openings and extending portions to the rim. Patent 1607884. W. H. Farley, Sanderson, Texas.

THREAD GUARD FOR SPINNING AND TWISTING FRAMES.—Which effectually functions to prevent, in event of breakage of a thread, the free end from coming in contact with the next adjacent bobbin. Patent 1608389. J. Gullong and E. Brault, 16 Newton St., Holyoke, Mass.

LUBRICATING RAPIDLY-REVOLVING SPINDLES.—As in cream separators and the like, having means for facilitating the passage of the lubricant through the upper neck-bearing. Patent 1608413. F. Mortensen, c/o Maskin-Och Brobyggnada Aktiebolaget, Helsingfors, Finland.

SLIDE MEMBER FOR CALCULATING MACHINES.—Comprising a slide, an indicia-bearing tablet, a revoluble clip holding the tablet end, and guides defining a passageway for the slide. Patent 1608035. L. D. Roberts, 223 Main St., Shawano, Wis.

CROWN BLOCK.—Designed for use with gin poles, and especially adapted to facilitate stringing up for the purpose of pulling rods or sections of tubing from oil wells. Patent 1607663. A. Boynton, c/o Frontier Oil Co., San Antonio, Texas.

GEAR.—A timing gear which is noiseless, and adjustable, for embodiment in practically all sizes and types of machinery. Patent 1608050. W. A. Bailey, Declo, Idaho.

VALVE.—For use in connection with vapor top tanks, it being of such arrangement that closure of any particular tank may be made effective. Patent 1608178. J. W. Loftin, R. 2, Box 13, Depew, Okla.

DRILL. — In which a reciprocating drill bit cooperates with the casing in regulating a flow of water through the bit to the surface attacked. Patent 1605331. B. B. and E. R. Dudley, 797 Highland Ave., Piedmont, Calif.

BEARING.—A thrust bearing for carrying shafts capable of deflection with the shaft to maintain the pressure between the bearing surfaces evenly distributed. Patent 1608913. A. S. J. Stovall, Elberton, Ga.

SHUTTLE GUARD.—Incorporated in the lay of a loom for preventing the shuttle from accidentally jumping out of the shuttle race and injuring the loom or operator. Patent 1609263. R. C. Meisterknecht, 718 North 4th St., Allentown, Pa.

DRUM FOR COTTON CLEANERS.—Comprising a drum casing, a plurality of spiked and unspiked slats, and means by which the slats are secured in the drum casing in alternation. Patent 1608653. Van Don Harlan, Humphrey, Ark.

BEARING-TRIMMING TOOL.—A small machine particularly adapted for accurately and quickly trimming the ends of Babbitt metal bushings in the bearing caps of automobile engines. Patent 1608659. T. A. Jensen, Innisfail, Alberta, Canada.

LOOM ATTACHMENT.—For reducing at the proper time the force required for the execution of the picker motion and greatly reducing the wear on all parts. Patent 1609809. A. P. Gascon, 59 Appleton St., Providence, R. I.

ENVELOPE-SEALING DEVICE.—By means of which the flap is unfolded, passed over a rotary moistening drum, relieved of its surplus moisture, folded and pressed. Patent 1608820. A. J. Schaub, Sr., 1522 Fifty-fifth Ave., Oakland, Calif.

Prime Movers and Their Accessories

TRANSMISSION MECHANISM.—A planetary transmission for automobiles, capable of being operated by a standard gear-shift lever, and will give three speeds ahead and one in reverse. Patent 1610040. E. S. Clark, P. O. Box 817, Royal Oak, Mich.

VISUAL INDICATOR.—Intended to indicate the state of the circulation of fluids in a system of pipes or conduits; for example, in an automobile or other motor. Patent 1611,659. J. E. Malivert, c/o C. Chassevent, 11 Boulevard de Magenta, Paris, France.

FUEL PUMP AND GOVERNOR MECHANISM FOR OIL ENGINES.—An injecting apparatus for oil engines of the "Diesel type," for automatically supplying and governing oil fed to the engine during operation. Patent 1612600. D. O. Barrett, R. D. No. 1, Springfield, Ohio.

STEAM ENGINE.—In which water and steam are circulated for heating the water in a minimum of time, and bringing the steam to a very high pressure. Patent 1612208. F. Olson, Vik-i-Sogn, Norway.

INTERNAL-COMBUSTION MOTOR. — Which reduces to a minimum the number of working parts, by the elimination of crank shafts, connecting rods, pocket valves, and valve-operating means. Patent 1613136. S. Schiffelin, 55 Gramercy Park, New York, N. Y.

CARBURETOR.—Wherein the fuel and air in the mixing chamber is automatically controlled by the operation of the throttle which regulates the speed of the engine. Patent 1611792. S. and G. Sykes, 405 N. Humphrey St., Flagstaff, Ariz.

Pertaining to Vehicles

PROTECTIVE COVER FOR AUTOMOBILES. — Adapted to be supported as a compact unit above a car in the garage, and lowered to form a dust guard, comprising walls and top. Patent 1607950. H. W. Hartzell, Box 760, Madison, Kansas.

SEAT FOR THE CHASSIS OF AUTOMOBILES OR TRUCKS.—Which may be readily assembled as a seat and foot rest for a dismantled car when the car is to be driven from a factory. Patent 1608033. W. C. Nabors, c/o Nabors Garage, Mansfield, La.

BRAKE BAND. — In which the lining is rugged and durable, and may be removed and replaced in a few minutes without requiring the services of an expert mechanic. Patent 1608437. V. Shakespeare, 202 Livermore Ave., W. New Brighton, N. Y.

STEERING GEAR OF TRACTORS OF THE TANK TYPE. — Whereby a tractor when drawing an implement or vehicle will be automatically caused to return to its correct course after an accidental deviation. Patent 1608444. R. F. Thomas, c/o Collison & Co., 483 Collins St., Melbourne, Australia.

TRAILER ATTACHMENT FOR VEHICLES.—For attaching the reach pole of a trailer to the rear bolster of the leading truck, so that the pole may swing both vertically and horizontally. Patent 1608660. W. C. Nabors, Mansfield, La.

AUTOMOBILE HEADLIGHT.—Which utilizes the ordinary high power headlight, but also supplies adequate illumination and signalling facilities, while eliminating blinding glare liable to result in accidents. Patent 1608,830. W. C. Alford and W. M. Cassetty, 209—22nd Ave., North, Nashville, Tenn.

SWITCH.—A mechanism which will operate electric signals in response to the customary motions of the steering wheel of a motor vehicle, when it is pursuing a course straight ahead or one deviating to the right or left. The inventor has been granted two patents, 1605352 and 1605353. C. R. Krone, 410—28th St., Oakland, Calif.

TIRE CARRYING AND CHANGING RACK.—Which may be readily expanded within a tire and rim to snugly hold the same against accidental removal or rattling, or contracted for desired removal. Patent 1608126. D. H. Kuhnle, 1 Plato St., San Francisco, Calif.

VEHICLE DOOR OPENING AND CLOSING DEVICE.—Particularly adapted for taxicabs, wherein means are provided capable of operation by the passenger or the driver, the door will automatically lock. Patent 1609815. J. P. Hainzigianis, c/o Cutter, Phillips & Hall, 25 Broadway, New York, N. Y.

TRAILER CONNECTION.—Which takes up shocks and jars, permits all necessary movement in rounding curves and in traveling over irregular or rough ground. Patent 1610083. E. M. Franzen, 2435 Bonar St., Berkeley, Calif.

TIRE-TREAD VULCANIZING MOLD. — For vulcanizing new treads upon tires, and when in the operation of retreading, will confine the heat for vulcanizing to the tread itself. Patent 1608816. L. L. Ruark, Box 183, Coalinga, Calif.

SHOCK ABSORBER.—Especially designed for use with tow lines for towing automobiles. The device is compact and provides for a gradual application of the strain. Patent 1609900. E. B. Bishop, 221 Salisbury St., Raleigh, N. C.

GAGE.—For determining the position of a piston relative to the cylinder in which it works; may be used by those without special skill in valve timing. Patent 1609714. G. G. Hash, 508 Edith St., Missoula, Mont.

VEHICLE BODY.—So constructed that the driving compartment and the tonneau may be thrown together, to provide a single compartment, with a full-length bed. Patent 1610065. J. E. Meyer, c/o Burton T. Bush, Delawanna, N. J.

SPRING-ATTACHING TOOL. — Capable of effecting the movement of an axle housing relatively to a cushion spring, to permit the proper association of the housing to the spring. Patent 1611023. T. J. Gorman, Sr., and T. J. Gorman, Jr., 322 Mt. Pleasant Ave., Newark, N. J.

Our Book Department

Public opinion can make or break anything. This is especially applicable to books. Public opinion has made the following *Scientific American's* BEST SELLERS.

The New Theories of Matter and the Atom, by Berthoud	$3.65
Blue Print Reading and Shop Sketching, by Givens	1.90
*Modern Pise Building, by Ellington	2.65
Power Development of Small Streams, by Harris	3.70
Real Estate-Principles and Practices, by Benson	5.20
Bookkeeping and Introductory Accounting, by Sweeney	4.20
Practice Papers and Forms for Above	2.10
Atoms and Rays, by Lodge	3.20
Practical Mathematics, by Hobbs, et al	1.65
Descriptive Astronomy, by Moulton	2.15
The Electron, by Millikan	2.15
Concerning the Nature of Things, by Bragg	3.15
The A B C of Atoms, by Russell	2.15
Ether and Reality, by Lodge	2.15
How Radio Receivers Work, by Roberts	1.15
Curiosities of the Sky, by Serviss	3.15
Clockmaking, by Gordon	5.20
Elements of Radio Communication, by Stone	3.15
General Physics, by Webster, et al	3.90
*Chemical Calculations, by Jaffee	1.40
Learning to Fly in the U. S. Army, by Fale	1.65
Text-Book of Aeronautical Engineering, by Klemin	4.65
Evolution and Creation, by Lodge	2.10
*Thinking About Thinking, by Keyser	1.10

*Best sellers in order named.

All prices postpaid

Electric Development as an Aid to Agriculture
By G. E. Tripp
Chm. of Board, Westinghouse Electric & Mfg. Co.

An economic consideration of the future development when superpower becomes available over large areas of contiguous territory. Published by G. P. Putnam's Sons. $1.40 postpaid.

Bookbinding as an Art
By M. K. Dutton

The fascinating story of bookbinding, told in most entertaining style, with a completeness which makes it a work of reference. A needed contribution to bibliography. Published by The Holliston Mills, Inc.

World Almanac for 1927
R. H. Lyman, Editor

The forty-second year of publication of this invaluable reference, without which no library or source of general information is complete. Published by New York World. Cloth, $1.10 postpaid. Paper, 60 cents postpaid.

Tropical Cyclones
By I. M. Cline
U. S. Weather Bureau

Of considerable interest just now is this work, the result of forty years' study on the Gulf coast, covering the origin, behavior and forecast of cyclones. Original conclusions upset many established theories. Published by Macmillan Co. $5.20 postpaid.

The Origin of Birds
By G. Hellman

This noted Danish scientist gives a vivid and scientific study of prehistoric flying creatures in their relation to the birds of the present. The profusion of sketches and restorations enhance the text. Published by D. Appleton & Co. $7.70 postpaid.

Benjamin Garver Lamme, an Autobiography

The designer of the great generators for Niagara and other epoch making machinery tells of his characteristics and aptitudes in a close analysis, as a help to others in determining their best field of effort. Published by G. P. Putnam's Sons. $3.20 postpaid.

Ship Model Making, Volume II
By E. A. McCann

Detailed instructions on how to make a model of the American Clipper ship including the rigging and gear, with list of tools and materials needed. Published by N. W. Henley Pub. Co. $2.65 postpaid.

Stability and Seaworthiness of Ships
By T. A. Abell
Prof. Naval Architecture, Univ. of Liverpool

Of interest to all those who prepare a ship for her voyage and to the engineering officers who have in charge the many appliances which secure her stability. Published by University Press of Liverpool. $4.65 postpaid.

Principles of Human Geography
By V. de la Blache

The founder of the modern French school of geography and the teacher of a generation here surveys the world, past and present, with the erudition of a great scholar, tracing the vital influences which have affected mankind. Published by Henry Holt & Co. $5.20 postpaid.

Forest, Steppe & Tundra
By M. D. Haviland

These studies in animal environment faithfully correlate plant growth with physical surroundings which determine the three great divisions. An elaboration of lectures given at Cambridge University. Published by Macmillan Co. $5.20 postpaid.

For Sale By

SCIENTIFIC AMERICAN
24 West 40th Street
New York

CONTENTS
MARCH 1927

ARTICLES

The Signal Corps of the 'Movies'—By A. P. Peck 159-161
The Simplest Atom of All—By Prof. Hugh S. Taylor 162-163
Our Point of View—Editorial 164
Doubtful Newspaper Astronomy—By Prof. Henry Norris Russell, Ph.D. 165
Micro Motion-Pictures—By Heinz Rosenberger 166-167
How a Great Museum Serves the Public 168-169
Uncle Sam Spendthrift—VII—By J. Bernard Walker 170-172
The Month in Medical Science—By Morris Fishbein, M.D. 173
Marconi Strides Onward—By Orrin E. Dunlap, Jr. 174-175
Inventors Who Have Achieved Commercial Success—By Milton Wright 176
New Glass Allows Ultra-Violet Rays to Enter the Home 177
Railroad Changes River's Course—By J. Bernard Walker 178-179
Psalmist's Spring to Supply Jerusalem with Water—By Harold J. Shepstone 180-181
How Is Your Automobile Radiator Made? 182-183
Carl E. Akeley—Naturalist, Explorer and Inventor 184-185
Solar Whirlwinds Made Visible—By Lee McCrea 186
Swamps Reclaimed by Weed-Cutting Machines 187
New British Tanks, Field Artillery, and Military Cars with Road Wheels, and with Tracks for Rough Ground 188-189
Deep-Sea Fish Angle for Their Own Kind 194

DEPARTMENTS

Novel Devices for the Shop and the Home 190-193
Scientific American Digest 195-199
In the World of Chemistry 200-201
Learning to Use Our Wings—A Department of Aviation News 202-208
Radio Notes 209-214
The Heavens in March 214
In the Editor's Mail—Where Reader Meets Reader 215-217
Applied Science for the Amateur 218-220
Commercial Property News 221-222
Patents Recently Issued 222-223

INDEX TO ADVERTISERS

Absorbine, Jr. 215
Adams & Barre Company 211
American Farm Machine Company 216
American Lead Pencil Company 216
American Pipe Bending Machine Co. 211
American Sheet & Tin Plate Co. 207
American Telephone & Telegraph Co. 206
Arguto Oilless Bearing Company 202

F. Bannerman Sons 215
Bernard & Heller 216
Bradley Polytechnic Institute 208
Broderick & Bascom Rope Company 211
Burgess Battery Company 212

Camera Craft Publishing Co. 211
Chicago Stock Gear Works 208
Commercial Solvents Corporation 212
Cortez Cigar Company 216
Cushman & Wakefield, Inc. 220

Dayton Steel Foundry Company 208
F. J. Drake & Company 208

M. E. Fielden 216
Firestone Tire & Rubber Co. 215

General Electric Company ..... Fourth Cover
Gilson Manufacturing Company 206
Gilson Slide Rule Company 215

Harper & Brothers 208-218
L. R. Himes 206
Hotel Fort Shelby 216

International Harvester Co. of America, Inc. 154

Kelsey Company 216
Kokomo Brass Works 214

Laboratory Materials Company 215
Lambert Pharmacal Company 204-205

Metallic Sign Letter Co. 216
W. & D. Mogey 216
Moore & Company 206
Munn & Company 215-219

National Carbon Company 209
National List Company 216
Nestler Rubber Fusing Co. 206
Nicholson File Company 219
Norton Company 201

Packard Motor Car Company ..... Third Cover
Portland Manufacturing Co. 203

Schwerdtle Stamp Company 216
Scientific Apparatus Corp. 206
Self Acting Life Belt Co. 216
Simonds Saw & Steel Company 217
James Sinclair 216
Skayef Industries, Inc. 153
Stephenson Laboratory 216
Stewart Iron Works Co., Inc. 214

Taylor Instrument Companies 210
Timken Roller Bearing Company, Second Cover

Unisol Manufacturing Company 216
Universal Motor Company 211

Veeder Manufacturing Company 210
Vilter Manufacturing Company 208

Wisconsin Electric Company 217
Wisconsin Motor Manufacturing Co. 213

Henry Zuhr, Inc. 216

SCIENTIFIC AMERICAN PUBLISHING COMPANY
Munn & Company, 24-26 West 40th Street, New York

ORSON D. MUNN, President — LOUIS S. TREADWELL, Vice-President
JOHN P. DAVIS, Treasurer — ALLAN C. HOFFMAN, Secretary and Advertising Director

EDITORIAL STAFF

ORSON D. MUNN, Editor — J. BERNARD WALKER, Editor Emeritus
ALBERT A. HOPKINS — ALBERT G. INGALLS — KATRINE A. CAMPBELL
LOUIS S. TREADWELL — MILTON WRIGHT
PROF. HENRY NORRIS RUSSELL — PROF. ALEXANDER KLEMIN
A. P. PECK

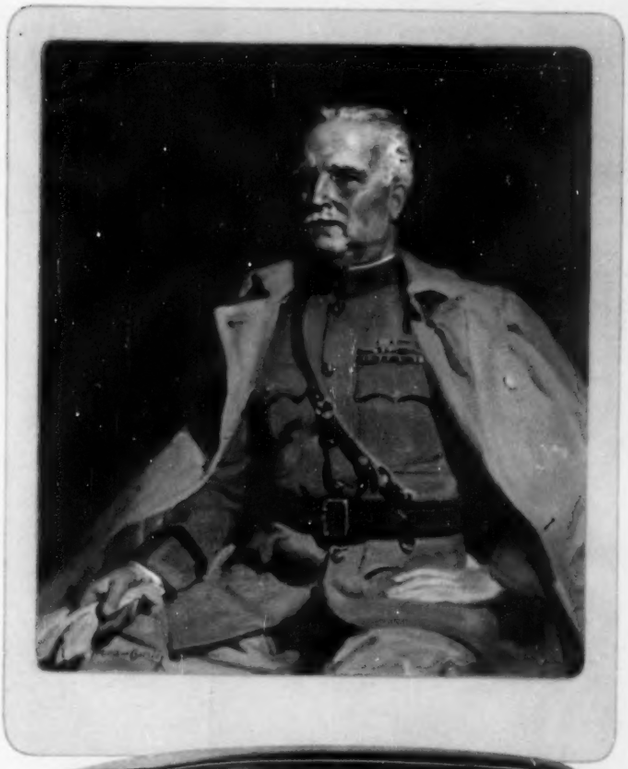
CORRESPONDING EDITORS

H. DIEDERICHS, Prof. of Experimental Engineering, Cornell University.
SAUL DUSHMAN, Ph.D., G. E. Research Laboratory.
RALPH J. FOGG, Prof. of Civil Engineering, Lehigh University.
LEON A. HAUSMAN, Ph.D., Asst. Prof. of Zoölogy, Rutgers College and State Univ. of N. J.
HARRY S. HOWER, Prof. of Physics, Carnegie Institute of Technology.
DAVID STARR JORDAN, Chancellor Emeritus, Leland Stanford Jr. University.
D. H. KILLEFFER, Associate Editor *Industrial and Engineering Chemistry.*
AUSTIN C. LESCARBOURA, A. I. E. E., Croton, New York.
M. LUCKIESH, Dir., Lighting Research Laboratory, National Lamp Works of General Electric Co., Nela Park, Cleveland.
D. T. MACDOUGAL, Director, Laboratory for Plant Physiology, Carnegie Institution of Washington.
ROY W. MINER, American Museum of Natural History.
H. F. MOORE, Research Prof. of Eng. Materials, University of Illinois.
RUSSELL W. PORTER, Optical Associate, Jones and Lamson Machine Company.
DR. WALTER FRANKLIN PRINCE, Research Officer, Boston Society for Psychic Research.
H. C. RAMSOWER, Director of Agricul. Ext. Service, Ohio State University.
SAMUEL J. RECORD, Prof. of Forest Products, Yale University.
PROF. H. H. SHELDON, Chairman of the Department of Physics, Washington Square College, New York University.
J. HAMMOND SMITH, Prof. of Civil Engineering, Univ. of Pittsburgh.

Western Advertising Office, Wilson and Galey, Harris Trust Building, Chicago, Ill.

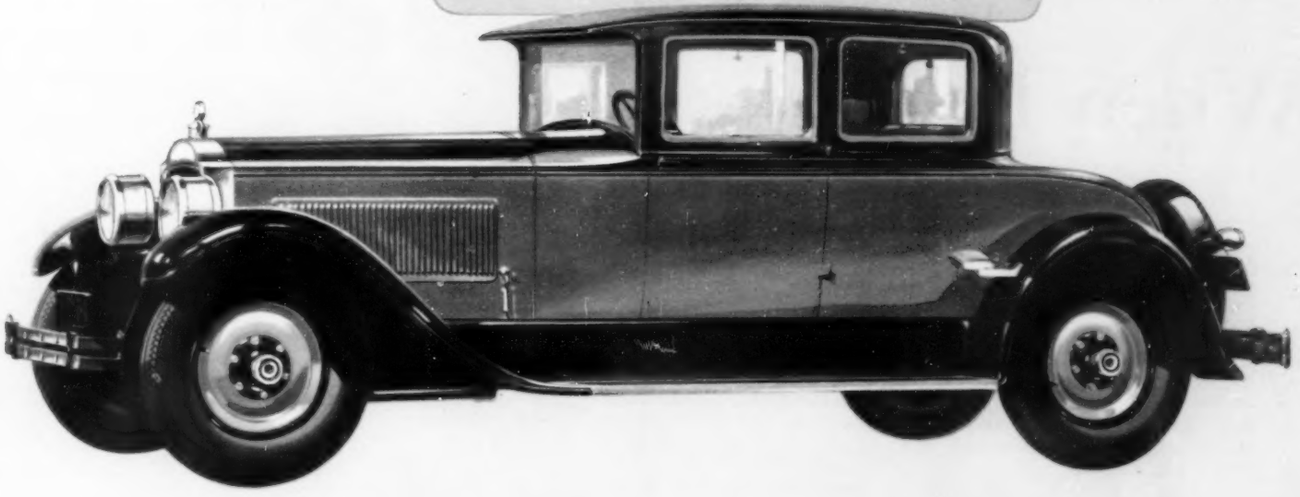
Vol. 136, No. 3. Published monthly. Entered as second class matter, June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.

Price, 35 cents a copy. $4.00 a year. Postage prepaid in United States and possessions, and Mexico, Cuba and Panama; $4.50 a year for Canada. Foreign subscriptions, $5.00 a year, postage prepaid.



The Restful Car

"The supreme combination of all that is fine in motor cars."



Reputation · Enduring fame is a sufficient reward to many for a lifetime of effort and great accomplishment. Certainly a well deserved and outstanding reputation is even more difficult to achieve than financial success.

Packard has achieved both. But Packard reputation today, after twenty-seven years of service to the public, is an even greater asset than Packard's absolute financial independence.

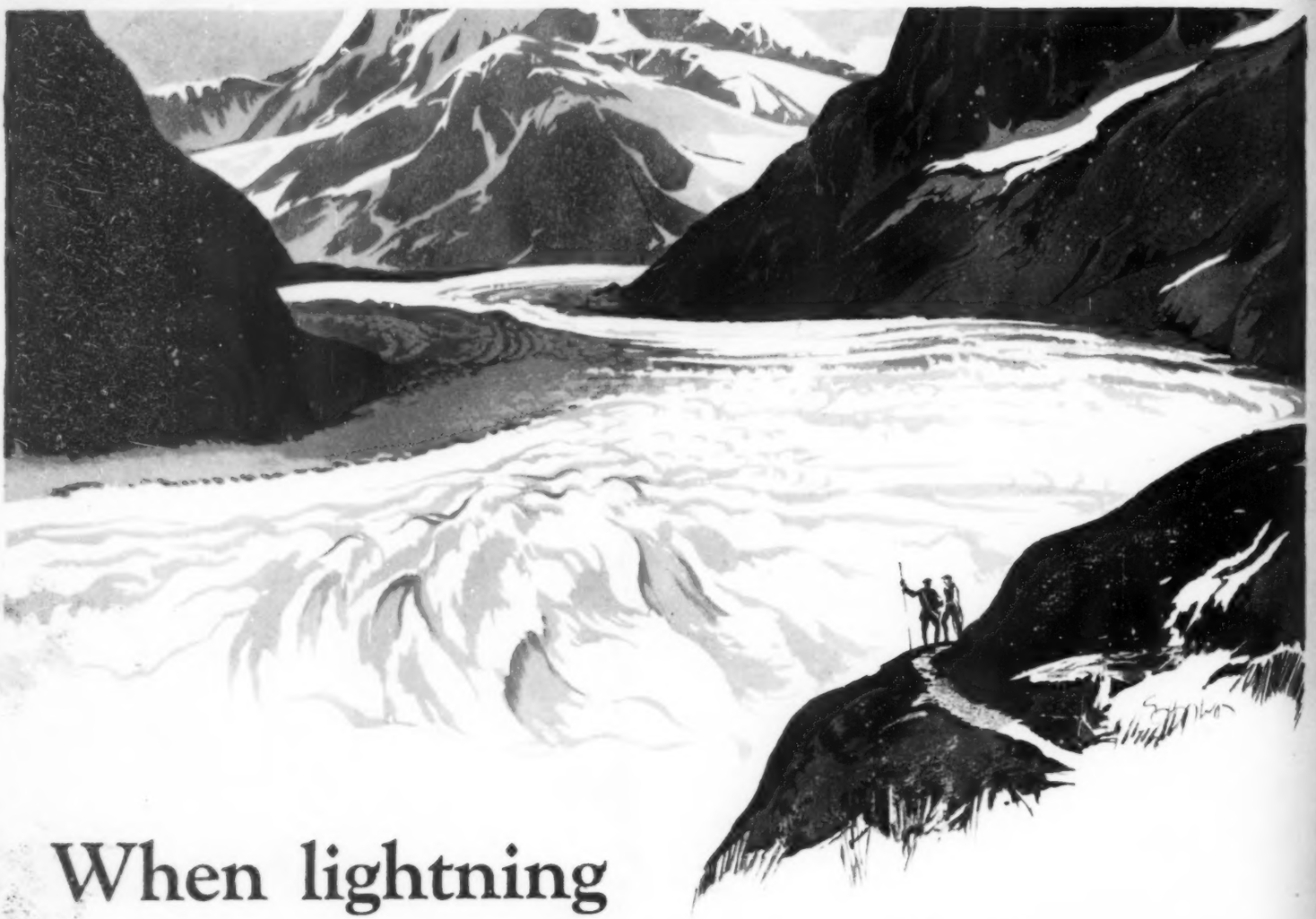
For Packard is a name which means superlatively fine motor cars in every quarter of the globe. And this reputation, so laboriously and deliberately built up, is more jealously guarded than all the gold in Packard's surplus.

It means more. For it reflects the confidence of the world in Packard vehicles—in Packard engines. Packard power has won international renown on the land, in the air and on the water. A generation of uninterrupted success and constant leadership is the best guarantee that that excellence of reputation will be sustained.

PACKARD

A S K T H E M A N W H O O W N S O N E

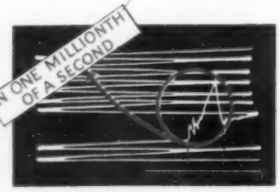
PERIODICAL ROOM
GENERAL LIBRARY



When lightning seems as slow as a glacier

It is easy to photograph a glacier because it moves but a few feet a year. But to photograph the effects of lightning on electric circuits—effects that come and go in millionths of a second—would seem impossible. Yet there is a man-made machine operated in the laboratories of the General Electric Company that does just this. It makes even lightning seem slow.

In the machine a swift-moving stream of electrons flashes across a photographic film. It dances out of its path when the freakish currents, caused by lightning, surge along the wires. There on the film is the footprint of lightning.



Above is one of the photographs—oscillograms they are called. The jagged curve is produced by the lightning. The surge traveled at the rate of thirty miles a second but it was recorded, and in the amazingly short time of one-millionth of a second.

It has made possible a study of the working of a lightning arrester—the ingenious device that protects the costly equipment of the power house as well as the very lights in your home.

Upon such scientific achievements as the cathode-ray oscillograph—lightning's camera—is the confidence in General Electric equipment founded. Many of these achievements are better known. The modern developments in x-ray, the service that has made MAZDA lamps a staple of commerce, the modern small motor that has taken drudgery out of household work—these are some of the milestones of progress.

GENERAL ELECTRIC